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ABSTRACT

An instructor's manual and student activity guide on making an adjustable C-clamp are provided in this set of prevocational education materials which focuses on the vocational area of trade and industry (metal work). (This set of materials is one of ninety-two prevocational education sets arranged around a cluster of seven vocational offerings: agriculture, home economics, distributive education, health occupations, world of work, trade and industry, and office occupations.) The instructor's guide is organized into the following elements: title of activity, duration of activity (six periods), activity goals, instructional objectives, and activity implementation (description, materials needed, safety considerations, teacher preparation prior to class, during the class, follow-up activities, and masters for duplication [e.g., final drawings of project, student answer sheet]). The student activity guide provides step-by-step instructions (narrative and illustrations) for completing each instructional objective (e.g., measure and cut stock, die threads in rod stock). At the end of each set of instructions is a student check point (evaluation activity). Occupational descriptions for a drill press operator, contour band-saw operator, and machinist conclude the document. (JH)

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# METAL WORK
# MAKING AN ADJUSTABLE C-CLAMP

**Kit No. 23**

## INSTRUCTOR'S MANUAL

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**In Cooperation With**

**Vocational Education Media Center**
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**Clemson, South Carolina 29631**

**1978**

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## TITLE OF ACTIVITY

Kit No. 23, Metal Work – Making An Adjustable C-Clamp

## DURATION

This activity will last six class periods.
Main Activity – 4 periods
Follow-up Activity – 1 to 2 periods

## GOALS AND INSTRUCTIONAL OBJECTIVES

FIRST DAY:

Introduction to Measuring, Layout, Hack Saw, File, Hand Drill. The student will read the material on these subjects and do Check Points provided at the end of each activity. The student will be able to measure, lay out a project, and use a hack saw, file, vise, and drill a hole with a hand drill.

SECOND DAY:

Introduction to the Drill Stand. The student will learn the parts of and how to use a tap and die. The student will read the material on these subjects and do the Check Point at the end of each activit,. The student will learn to use the drill stand and learn to tap a hole and use a die to cut outside threads.

THIRD DAY:

Begin making C-Clamp.

FOURTH DAY:

Making C-Clamp

FIFTH DAY:

Making C-Clamp

SIXTH DAY:

Completing the project.

## VOCATIONAL CLUSTERS

Trade and Industry

## ACTIVITY IMPLEMENTATION

### A. Description

FIRST DAY: The student will read the material on Measuring, Layout, Hack saw, Filing, Vise, Hand Drill, and do the Check Points at the end of each section.

SECOND DAY: The student will read the material on Drill Stand, Tap and Die, and do the Check Points at the end of each section.
THIRD DAY: Begin project – Making an Adjustable C-Clamp.
FOURTH DAY: Continue work on C-Clamp.
FIFTH DAY: Continue work on C- Clamp.
SIXTH DAY: Complete project.

### B. Safety

Be careful when using the scribe because it has a sharp point.

Be sure the handle is on the file tightly.

Be sure the vise is clamped securely to work bench.

Be sure metal is clamped tightly in the vise before sawing, filing, drilling, or threading metal.

Wear safety glasses at all times when drilling holes.

Be sure the cord on the electric drill is in good shape.

Remove chuck key from drill before starting drill motor.

Unplug drill when changing bits.

### C. Materials Required

1. Audio Visual Equipment
   None

2. Technical Equipment
   25 metal rules
   5 (five) 6" squares (15.24 cm)
   5 scribes
   5 center punches
   5 hack saws
   5 (five) 8" (20.32 cm) single cut, smooth files
   5 file handles (wooden)
   5 vises, 3" (7.62 cm) jaws
   5 (five) 8 ounce (226.8 g) ball peen hammers
   3 (three) 3/8" (.9525 cm) hand drills
   3 drill stands
   10 safety glasses
   15 taps 3/8 - 16
   15 tap handles
   15 dies 12-24
   15 die handles

3. Expendable Supplies
   2 pieces 4" (10.16 cm) long – ¾" x 1" (1.905 cm x 2.54 cm) rectangular stock per student
   4 (four) 3/8 x 16 nuts per student
   2 pieces 2" (5.08 cm) long, 3/16" (.47625 cm) rod per student
   4 (four) 12 – 24 nuts per student
   5 hack saw blades
   5 each 3/16, 5/16, 3/8 drill bits

**D. Preparation Prior to Class**

Order 20 feet (6.096 m) of ¾" x 1" (1.9050 cm x 2.54 cm) cold rolled steel.

Order 20 feet (6.096 m) of 3/8" (.9525 cm) threaded rod

1 box of 100 –3/8 – 16 nuts

Order 20 feet (6.096 m) of 3/16" (.47525 cm) rolled rod.

1 box of 100 12–24 nuts

Duplicate student answer sheet – 1 for each student

Read over Activity Guide and be aware of areas where safety rules are used.

**E. During Class Session**

Explain to each class that no one is to do any activity out of sequence. Tell the student to turn to page one of the programmed text for metal work. Read the instructional objectives, goals, directions, and then start on Instructional Objective I.

Read each step carefully. Check to see that each Checkpoint is completed and done correctly. The student should adjust to how the programmed text works. Let the students work at a steady pace – not too fast, or too slow. See that safety rules are followed and correct usage of each tool is observed. The main point to remember is to allow NO horseplay or clowning around. It is easy enough to get hurt using hand tools without help from someone else.

**F. Follow-up Activities**

1. Have students fill in VIEW Fact Sheet.
2. Identify in newspaper job openings as a machinist or metalworker.

**MASTERS FOR DUPLICATION**

VIEW Fact Sheet
Final drawings of project
Student Answer Sheet

## VIEW FACT SHEET

NAME _____ CLASS _____ OCCUPATION _____

A. List the advantages (good points) of this occupation (job).

B. List the disadvantages (bad points) of this occupation (job).

C. List three things you should know to do this occupation (job).
1.
2.
3.

D. What type of education should you get to be prepared (do) for this occupation (job)?

E. What courses must you take to go into this occupation (job)?

F. What do you think your future in this occupation (job) will be?

G. What wage can you expect in this occupation (job)?

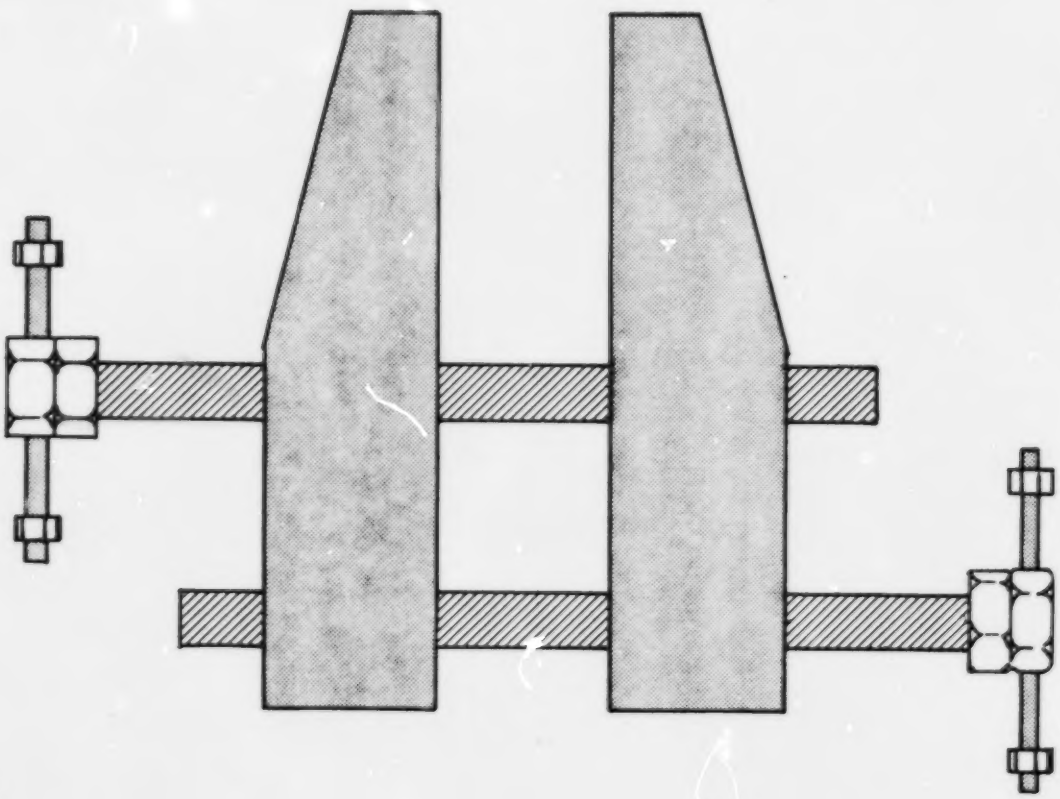
H. What are the working hours of this occupation (job)?

I. To learn more about this occupation (job), write to:

J. Using a scale of 1 to 5, circle the number that measures your interest in this occupation (job) as a possible career.

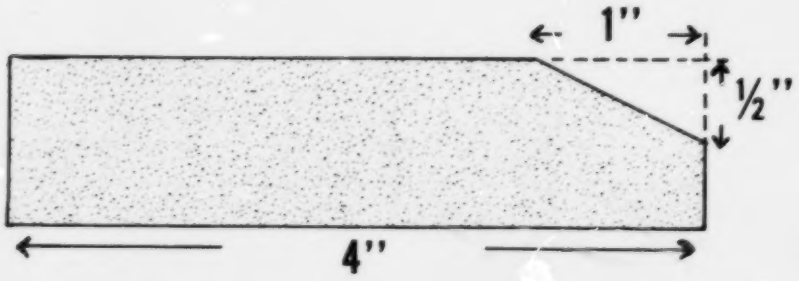
I don't like it. 1 2 3 4 5 I like it.

# ASSEMBLED



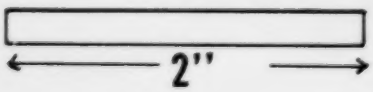
# "C" CLAMP

JAWS 2 NEEDED




5/16" THREADED ROD 2 NEEDED

3/16" ROD 2 NEEDED




ALSO (4) 12-24 NUTS

(4) 3/8" NUTS

## STUDENT ANSWER SHEET

### INSTRUCTIONAL OBJECTIVE I

1 _____
2 _____
3 _____
4 _____
5 _____

### INSTRUCTIONAL OBJECTIVE II

1 _____
2 _____
3 _____
4 _____
5 _____

### INSTRUCTIONAL OBJECTIVE III

A _____
B _____
C _____
D _____

### INSTRUCTIONAL OBJECTIVE IV

A _____
B _____
C _____
D _____
E _____

### INSTRUCTIONAL OBJECTIVE V

1 _____
2 _____
3 _____

### INSTRUCTIONAL OBJECTIVE VI

A _____
B _____
C _____
D _____
E _____
F _____

### INSTRUCTIONAL OBJECTIVE VII

A _____
B _____
C _____
D _____
E _____

### INSTRUCTIONAL OBJECTIVE VIII

A _____
B _____
C _____
D _____

### INSTRUCTIONAL OBJECTIVE IX

A _____
B _____
C _____
D _____

# METAL WORK
# MAKING AN ADJUSTABLE C-CLAMP

Kit No. 23

## STUDENT
## LEARNING ACTIVITY MANUAL

Prepared by

Jim White
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# MAKING AN ADJUSTABLE C-CLAMP

## INTRODUCTION

In this programmed text, the student will be instructed in basic layout principles, using a hack saw, file, vise, tap, and die to make thread, and using a table mounted drill press. The following activity will involve using all the information covered in the programmed text to construct an adjustable C—Clamp.

## GOALS

The student will learn to measure with a metal rule.

The student will learn the parts of and how to use a hack saw.

The student will learn the parts of and the use of a file.

The student will learn the parts of and the use of a vise

The student will learn the parts of and the use of a tap and die to cut threads.

The student will learn the parts of and how to use a table mounted drill press.

The student will learn and observe all safety rules needed to operate the equipment.

The student will do the self-test Check Point at the end of each section.

The student will make an adjustable C-Clamp.

## DIRECTIONS

To use the programmed self-instructional method of teaching, the student will begin with the Programmed Text.

The programmed text is a step-by-step process. In each section there will be an Instructional Objective which will explain briefly what the student is to do.

The sequence instruction is a step-by-step explanation of what is being done. It will be accompanied by a picture of each activity or a picture of the tool being explained in the instructional objective.

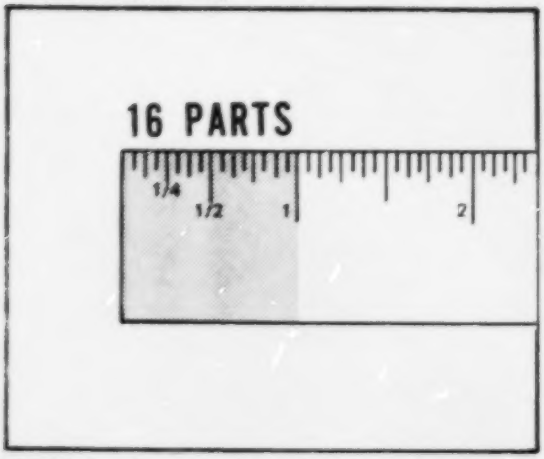
Each section of sequenced instruction will be followed by a Checkpoint. The check point will have a practice sheet with a short quiz on what was just covered.

Follow the programmed text in correct order.

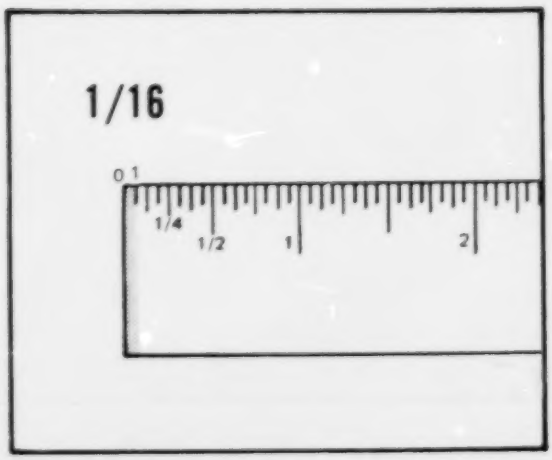
PROGRAMMED TEXT

# Instructional Objective 1

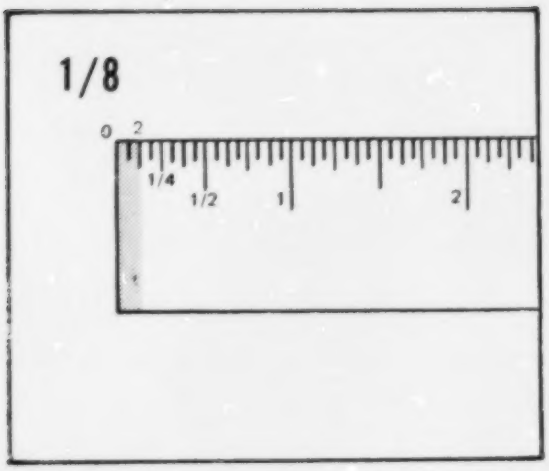
Being able to measure accurately is essential in doing metal work. A person working with metal must be able to measure lengths, read dimensions, and figure materials. Obtain a metal rule.



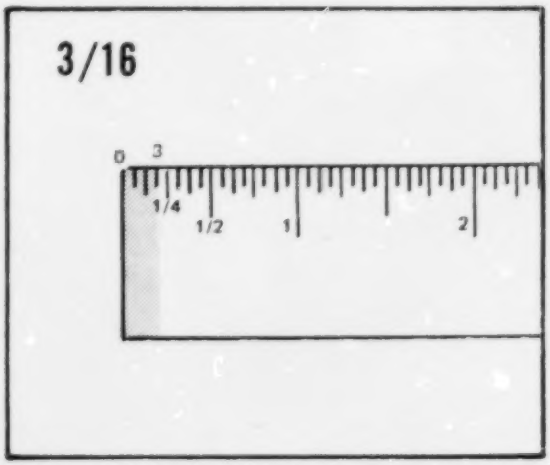

STEP 1 – To understand how to measure, you must understand the sixteen parts of an inch. This shows an inch broken down into 16 equal parts.



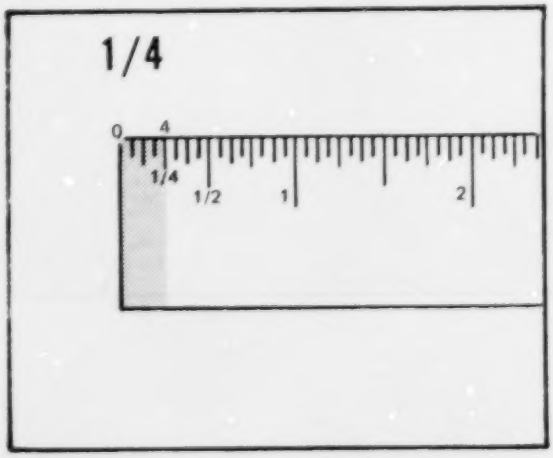

STEP 2 – From 0 to the mark labeled 1 is 1/16 inch.



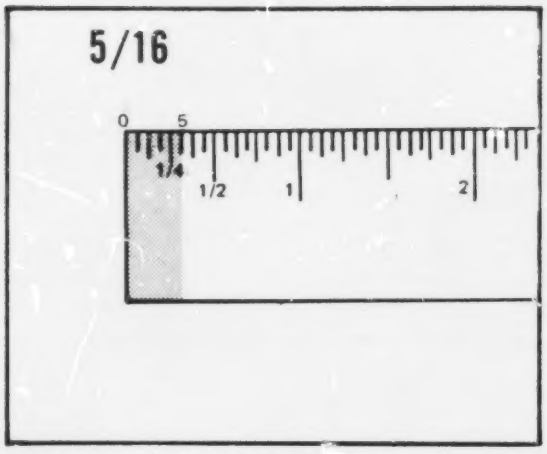

STEP 3 – From 0 to the mark labeled 2 is 2/16 or 1/8 inch; we will call it 1/8 inch.



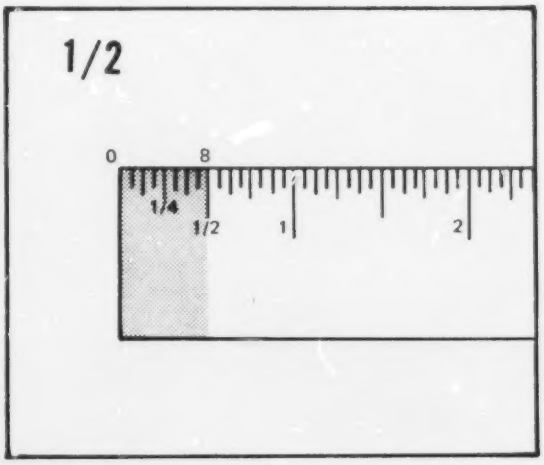

STEP 4 – From 0 to the mark labeled 3 is 3/16 inch.



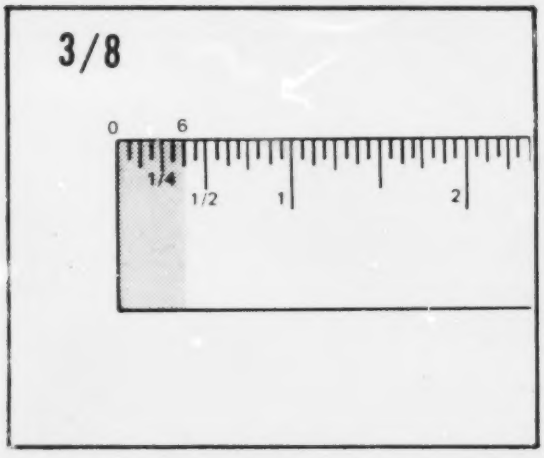

STEP 5 – From 0 to the mark labeled 4 is 4/16 inch or ¼ inch; we will call it ¼ inch.



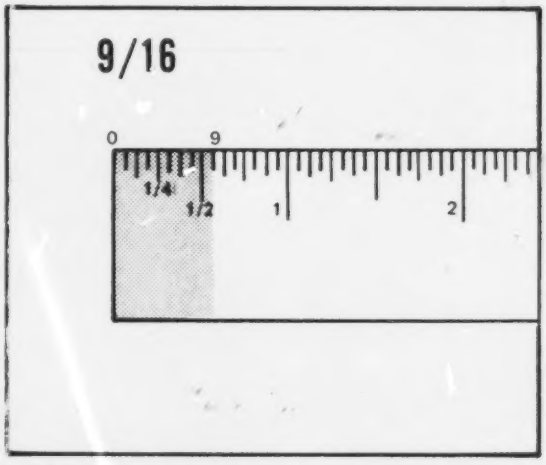

STEP 6 – From 0 to the mark labeled 5 is 5/16 inch.



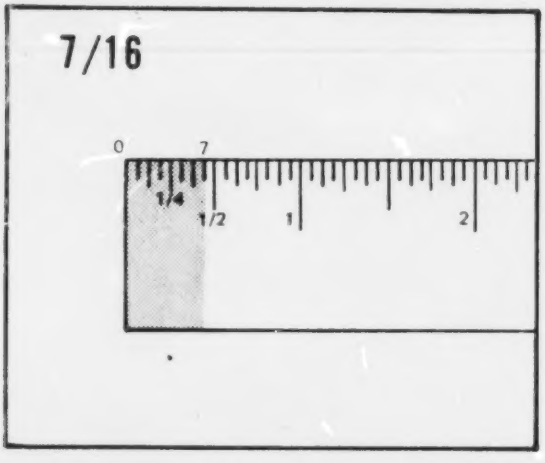

STEP 9 – From 0 to the mark labeled 8 is 8/16 inch, or ½ inch; we will call it ½ inch.



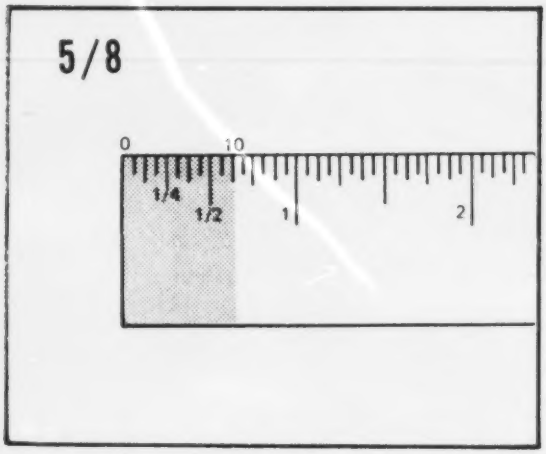

STEP 7 – From 0 to the mark labeled 6 is 6/16 or 3/8 inch; we will call it 3/8 inch.



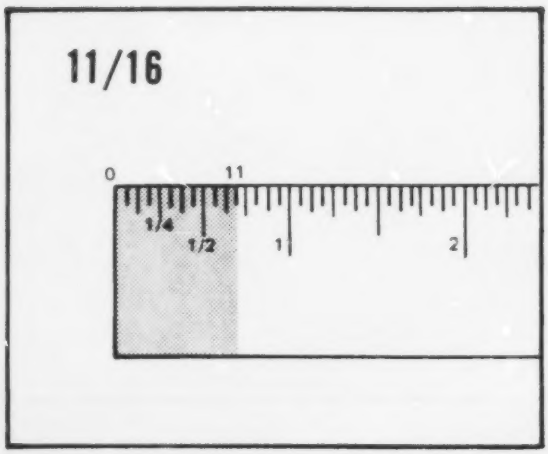

STEP 10 – From 0 to the mark labeled 9 is 9/16 inch.



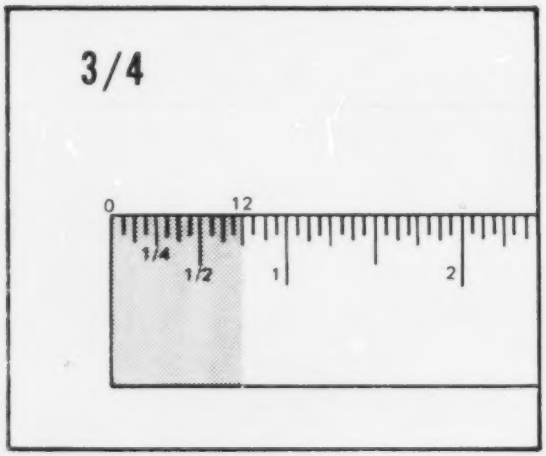

STEP 8 – From 0 to the mark labeled 7 is 7/16 inch.



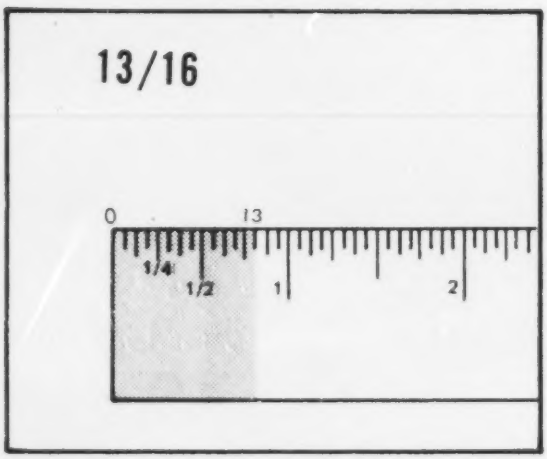

STEP 11 – From 0 to the mark labeled 10 is 10/16 inch or 5/8 inch; we will call it 5/8 inch.



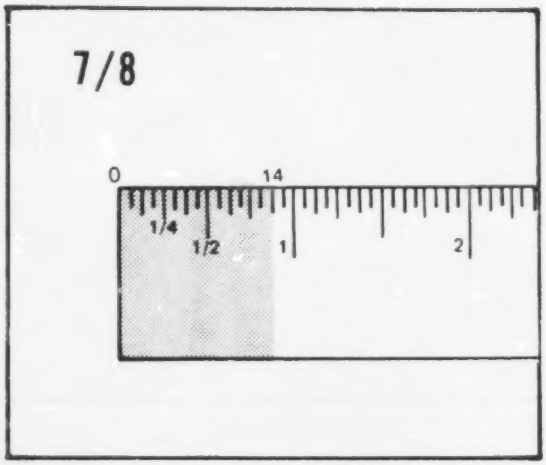

STEP 12 – From 0 to the mark labeled 11 is 11/16 inch.



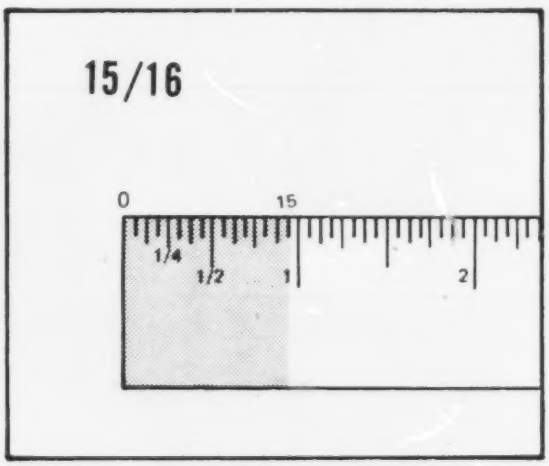

STEP 13 – From 0 to the mark labeled 12 is 12/16 or ¾ inch; we will call it ¾ inch.



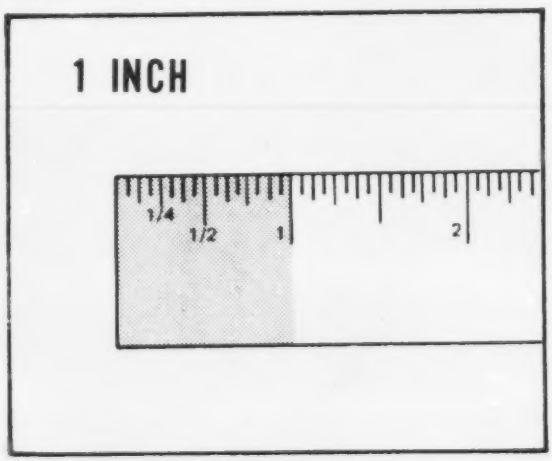

STEP 14 – From 0 to the mark labeled 13 is 13/16 inch.




STEP 15 – From 0 to the mark labeled 14 is 14/16 or 7/8 inch; we will call it 7/8 inch.




STEP 16 – From 0 to the mark labeled 15 is 15/16 inch.




STEP 17 – From 0 to the mark labeled 16 is 16/16 or 1 inch.

STEP 18 – Look at the first inch on the metal rule.

## Check Point

Using the metal rule and Student Answer Sheet, measure the lines to the right of the letters A, B, C, D, . . . . Select the correct measurement and place the letter in the space to the right on Student Answer Sheet for Instructional Objective I.

| | | |
|---|---|---|
| A | ¾" | 1 |
| B. | 4" | 2 |
| C. | ¼" | 3 |
| D. | 1½" | 4 |
| E. | 5 1/8" | 5 |

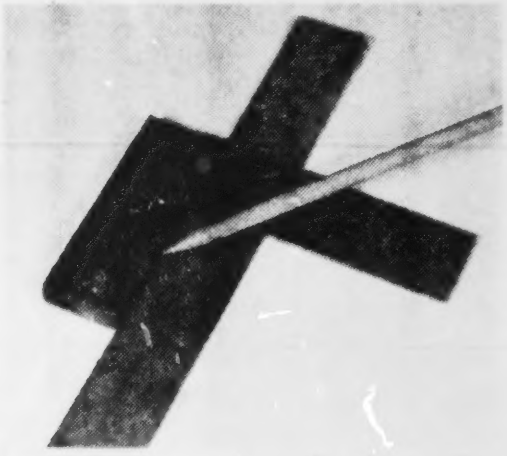
STEP 19: Check your answers.
1 – E, 2 – C, 3 – A, 4 – B, 5 – D

## Instructional Objective II

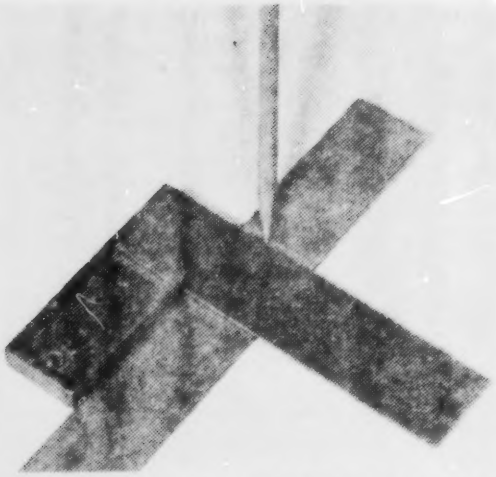
The student will be able to identify and use the five basic Layout Tools.

STEP 1 – The metal rule is 18 inches (45.72 cm) long and can be used as a straight edge for drawing lines.

STEP 2 – The second tool is the steel square. It is used to lay out and check right angles (90°).



STEP 3 – To use the square place the handle against the edge of the metal.



STEP 4 – This lets the blade lie across the metal. This lets you mark a line exactly 90° or a right angle.

STEP 5 – The third layout tool is the scribe and it has two main parts.

STEP 6 – The first part is the handle– this is what you hold the scribe with; the second is the blade which has a sharp point and is used to scratch a mark or line on the surface of metal.

STEP 7 – SAFETY RULE: Since the scribe has a sharp point caution must be observed. This point could punch a hole in your skin or cause eye damage.

STEP 8 – The fourth layout tool is the center punch. The punch has three main parts.

STEP 9 – Head, body and point; The body is what the punch is held by.

STEP 10 – The point is sharp and it is placed on a mark.

STEP 11 – The head is where you tap it with a hammer lightly to cause the point to make an indention in the metal.

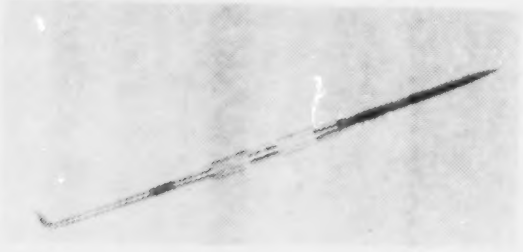
STEP 12 – The ball peen hammer is used to strike (hit) many of the metal working tools, for example the center punch.

# Check Point

Match the following tools with their names by placing the correct letter in the blank on your answer sheet for Instructional Objective II.

1. Ball peen hammer
2. Scribe
3. Center punch
4. Square
5. Metal rule

A.

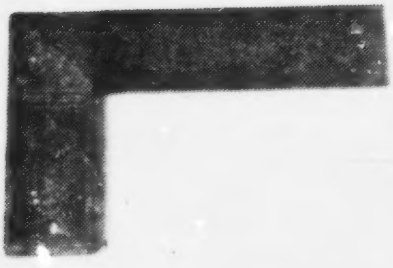


B.

C.

D.

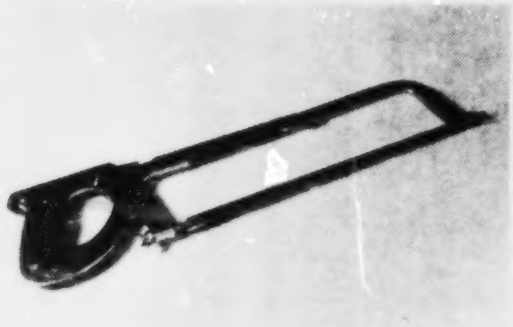
E.



STEP 13 – To check your answers: 1 - B, 2 - A, 3 - D, 4 - E, 5 - C

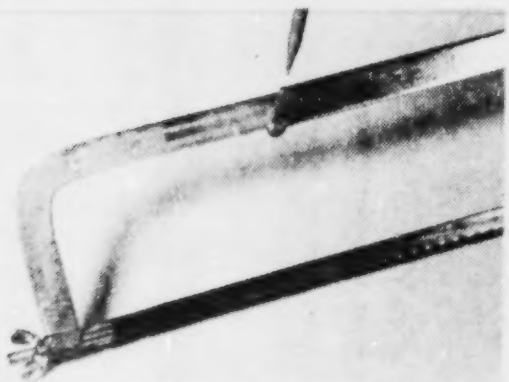
## Instructional Objective III

The student will become familiar with the parts of and the proper use of a hack saw.

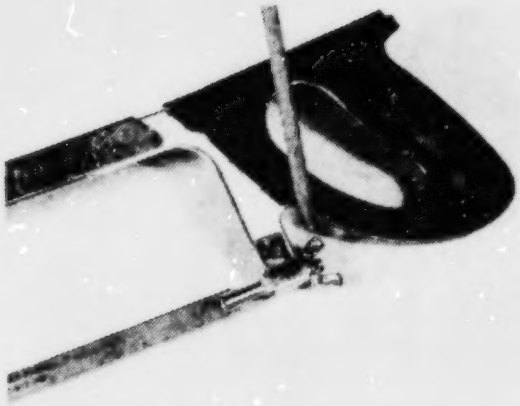


STEP 1 – The hacksaw has four major parts: The handle, frame, tension adjustment and the blade.

STEP 2 – The handle is shaped like a pistol grip to fit easily in the hand and make it more comfortable to use.



STEP 3 – The frame is shaped similar to the letter "U." IT IS ADJUSTABLE AND CAN BE SET TO FIT BLADES OF VARIOUS LENGTHS.



STEP 4 – The tension adjusting unit consists of wing nut and a sliding bolt. Its purpose is to apply tension on the blade.

STEP 5 – The blade is ½ inch wide (1.27 cm) and 0.25 inches (.635 cm) thick. The length can be either 8 inches (20.32 cm), 10 inches (25.4 cm), 12 inches(30.48 cm). The steel in a metal cutting saw blade must be harder than the metal to be cut, therefore, these blades are made of hardened steel. The size of teeth varies according to the number of teeth per inch.

STEP 6 – Pick the saw up and check to see that the blade is inserted correctly.

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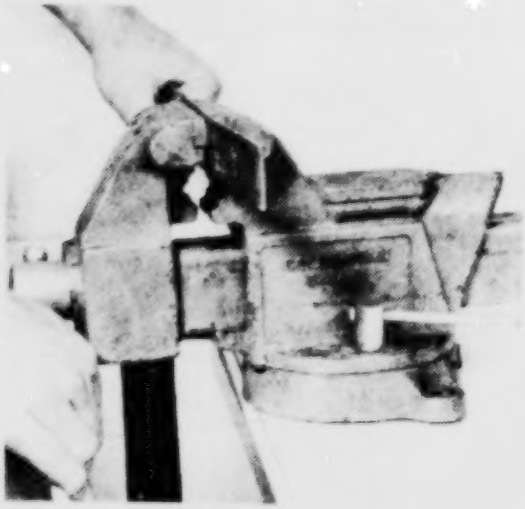
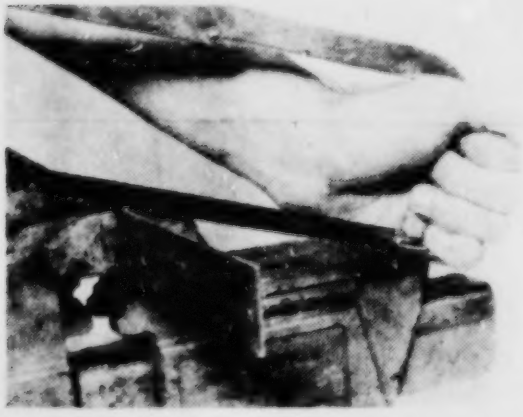
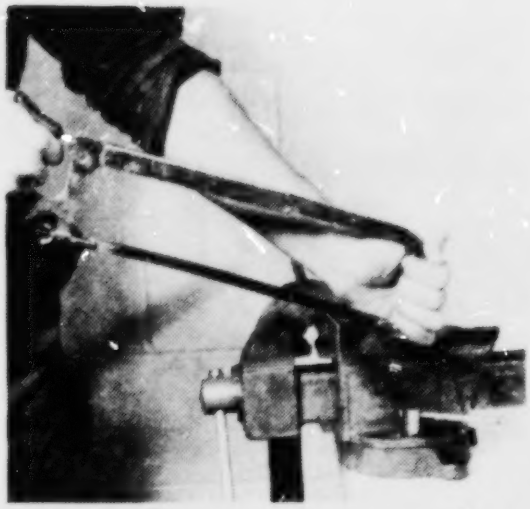
STEP 7 – Check the blade tension and adjust it if needed by turning the wing nut on the blade tension adjustment.



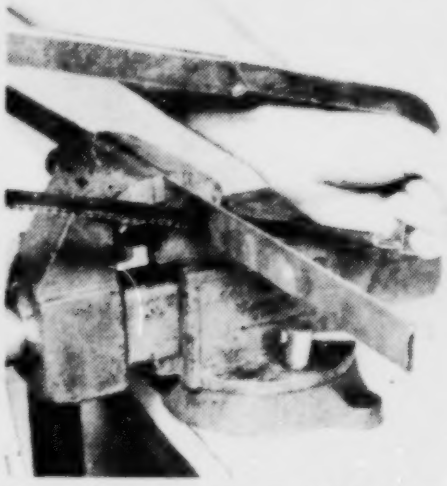
STEP 8 – The metal to be cut should be put in a vise.



STEP 9 – To start a cut, the blade should be placed on the metal with as many teeth as possible touching the metal.



STEP 10 – Stand in a relaxed position at the vise and hold the saw correctly.



STEP 11 – Put the saw blade down against the metal. Push the saw forward and apply just enough pressure to cause the blade to cut the metal.

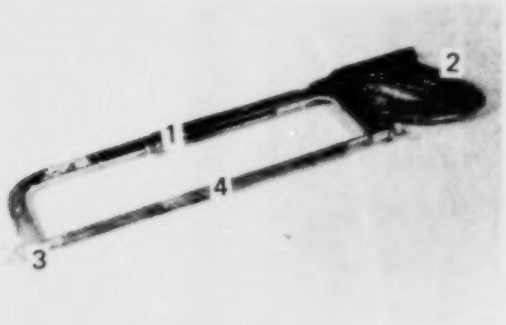
STEP 12 – Continue sawing with a light pressure until the cut is started. Do not use a rapid, jerky sawing motion; use a smooth back-and-forth motion, with a full stroke of the blade.

STEP 13 – Use less pressure on the saw when the cut is almost through the metal.

## Check Point

Match the parts of the hack saw with the correct name by placing the number in the blank on your answer sheet for Instructional Objective III.

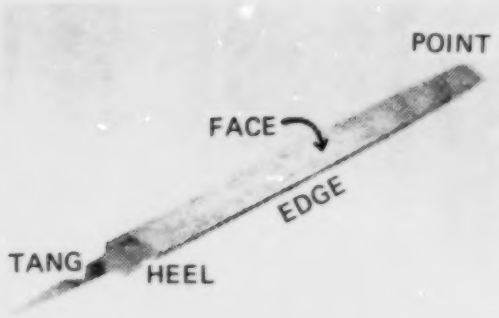
A. Tension adjustment
B. Blade
C. Frame
D. Handle



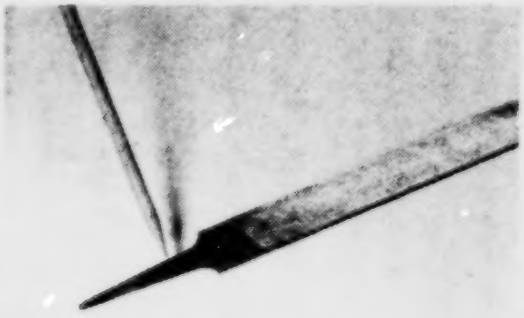

STEP 14 – To check your answers: A - 3, B - 4, C - 1, D - 2

## Instructional Objective IV

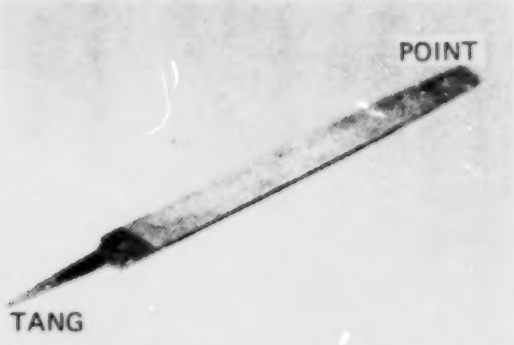
The student will identify the parts of a file and proper use of the file.



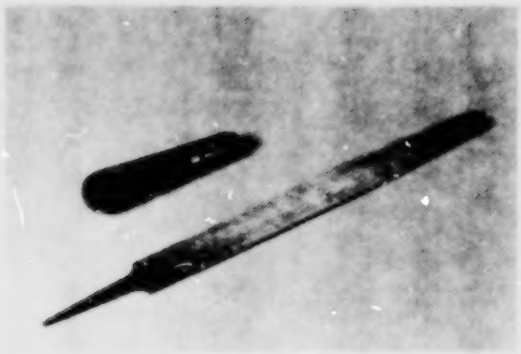

STEP 1 – There are five parts of a file: the point, face, edge, heel, and tang.



STEP 2 – The tang is the narrow end of a file where the handle is fastened.

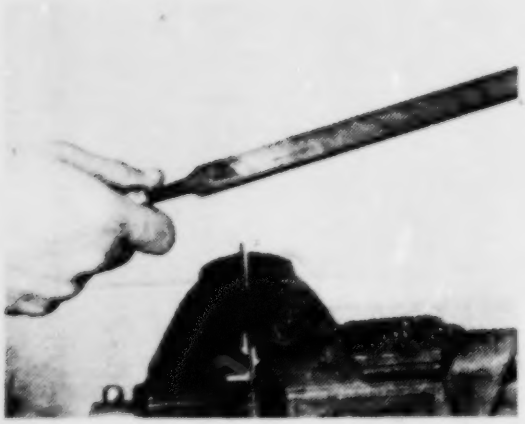



STEP 3 – The size of a file is according to its length from the end of the point to the base of the tang.

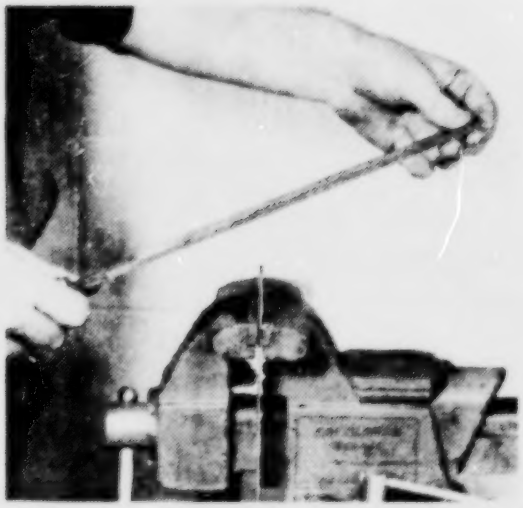


STEP 4 – A wooden handle fits on the tang and is tightened by tapping it on a table or floor.

STEP 5 – The teeth of the file are made of hardened steel because they must be harder than the metal being filed. The teeth do the cutting.



STEP 6 – Hold the handle in either the right or left hand according to which you favor.



STEP 7 – Grab the point with the thumb and first two fingers of the other hand.

STEP 8 – Stand in a relaxed position.

STEP 9 – Place the file flat on the metal with the teeth pointing to the front.



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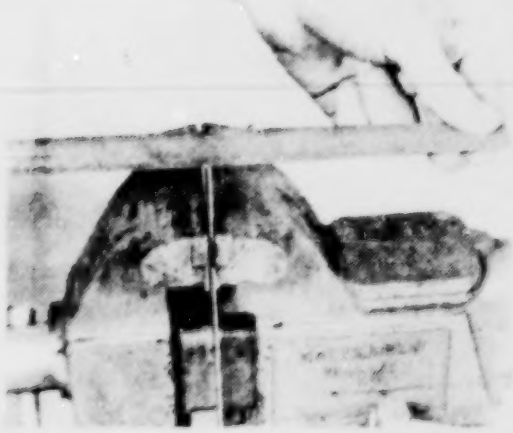
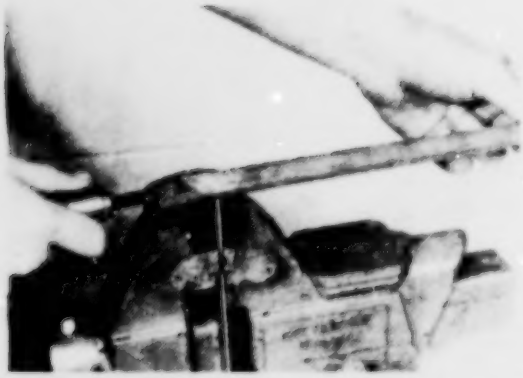
STEP 10 – Keep the file level and push it across the metal.

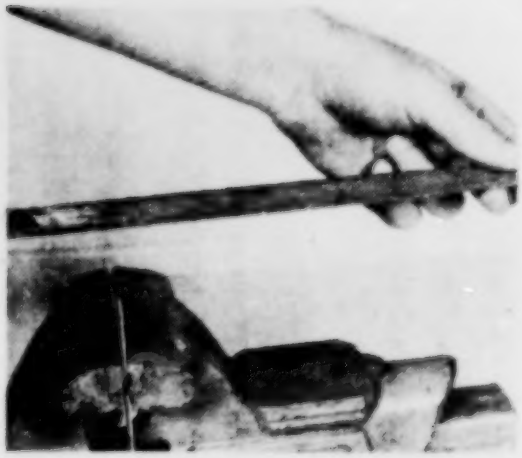
STEP 11 – Apply more pressure with the hand in front at the start of the stroke.



STEP 12 – Release some of the pressure of the front hand when the file reaches the center.

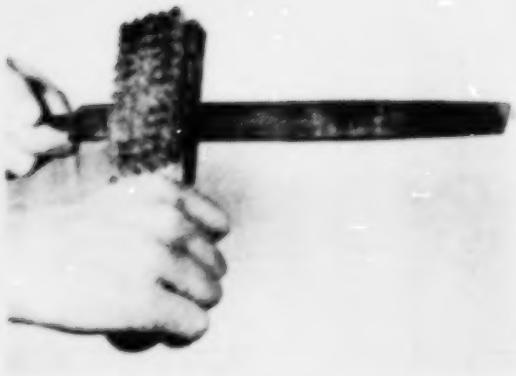


STEP 13 – Apply more pressure with the back hand for the rest of the stroke.



STEP 14 – The file cuts only in one direction on the forward stroke. It should be lifted on the return stroke.

STEP 15 – Keep the file from rocking on the metal; this is the most common error.

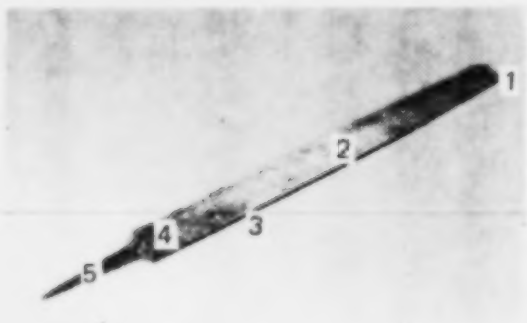


STEP 16 – Cleaning a file is done with a file card.

## Check Point

Match the parts of a file with the correct name by placing the number in the blank on the answer sheet for Instructional Objective IV.

A – Tang
B – Face
C – Point
D – Edge
E – Heel



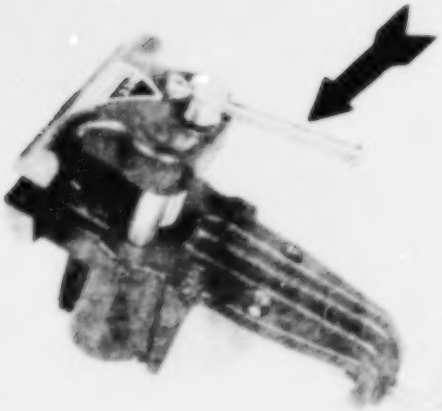

STEP 17 – To check your answers: A - 5, B - 2, C - 1, D - 3, E - 4

## Instructional Objective V

The student will identify the parts of a vise and will learn how to use the vise.

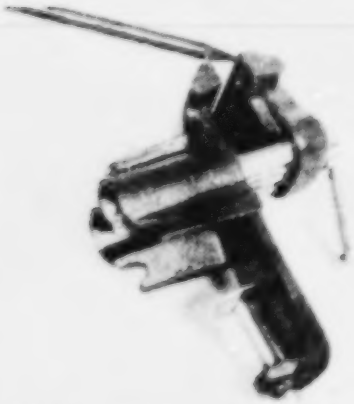
STEP 1 – There are four basic parts to a vise, the handle, table clamp, jaws, and body.

STEP 2 – The table clamp is adjustable so that it will fit different tables. The adjustment has a bolt going through it which, when run in, tightens on the table.



STEP 3 – The handle is on the end of a big bolt which tightens or loosens the vise.

STEP 4 – The body is the largest part of the vise; it gives the vise strength.



STEP 5 – The jaws are what clamp the metals in place.

STEP 6 – Using a vise to bend metal, place the metal in the vise and tighten the jaws against the metal.

STEP 7 – Pick up the 8 oz. (226.8 g) ball peen hammer.

STEP 8 – Start the bend by lightly hitting the metal case close to the vise.

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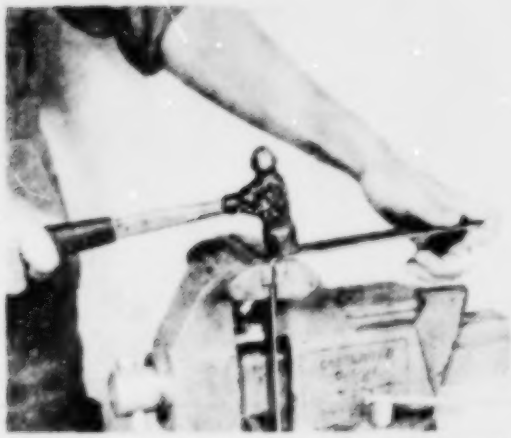
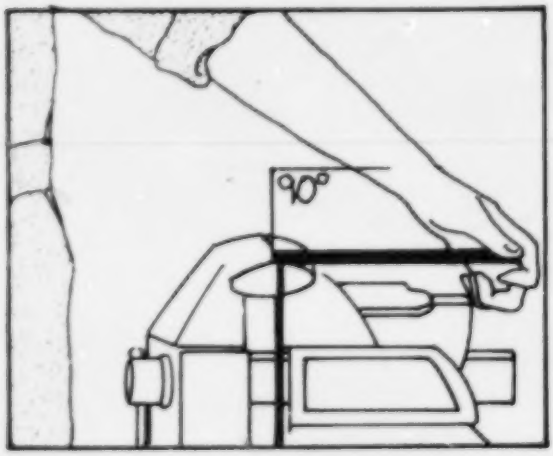


STEP 9 – Continue tapping the metal until it is bent down to 90° or a right angle.

STEP 10 – Take the metal out of the vise and check it with a square.



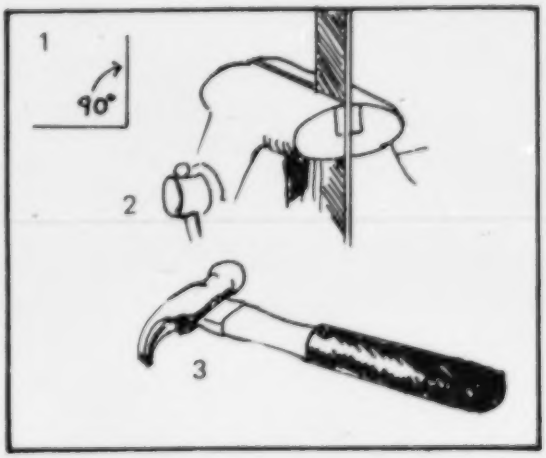

STEP 11 – If the metal is not 90°, put it back in the vise with the bend parallel to the jaws.

STEP 12 – Tap it with the hammer and then check it with the square.

## Check Point

Answer the following questions with either a YES or a NO in the blank on your Student Answer Sheet for Instructional Objective V.

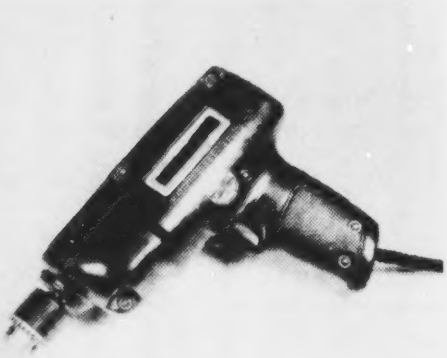
(1) This is a right angle
(2) This is the correct way to put metal in a vise before bending it.
(3) This is the correct hammer to use when bending metal.



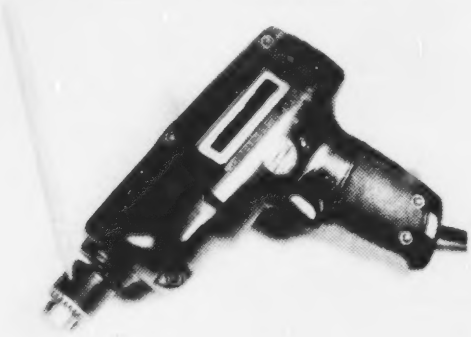

STEP 13 – When you have answered the questions, check your answers. 1 – yes, 2 – yes, 3 – no.

# Instructional Objective VI

The student will identify the parts of a 3/8" (.95 cm) hand power drill, how to use the drill correctly, and the safety rules which are observed when using a drill.

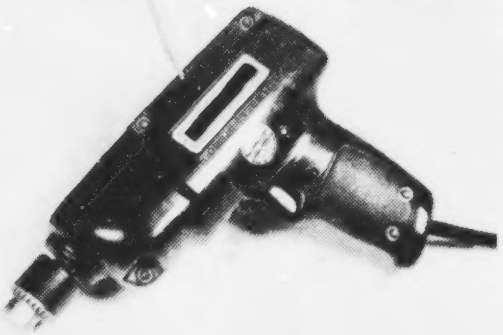


STEP 1 – The parts of a 3/8" (.95 cm) hand drill are the chuck, trigger switch, handle, power cord, and chuck key.

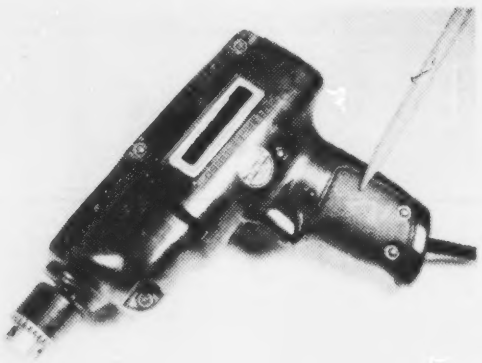


STEP 2 – The chuck holds the drill bit and it is tightened with the chuck key.

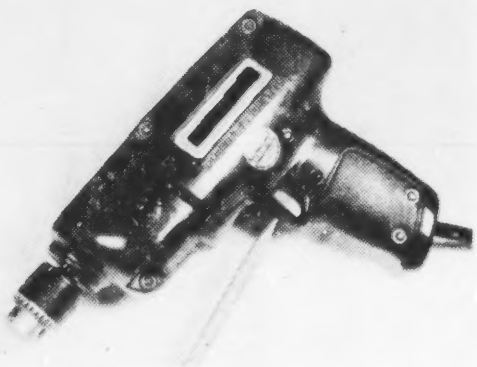
STEP 3 – The chuck key fits in the chuck.



STEP 4 – The frame of the drill protects the electric motor which drives the drill.



STEP 5 – The handle is used to hold the drill.



STEP 6 – The trigger switch is mounted in the handle; it is spring loaded to turn the drill off when you release the trigger.

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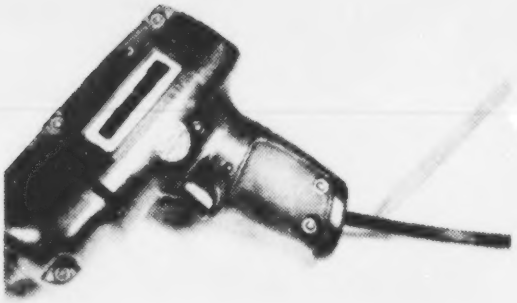
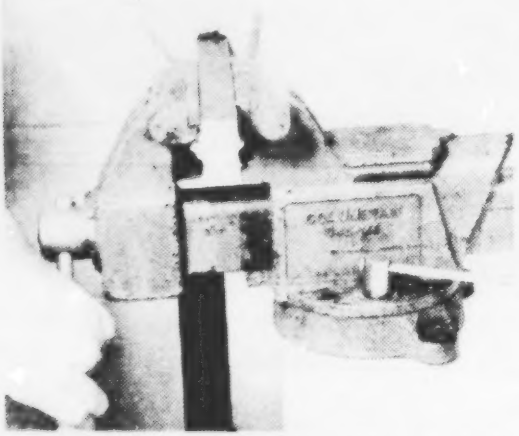
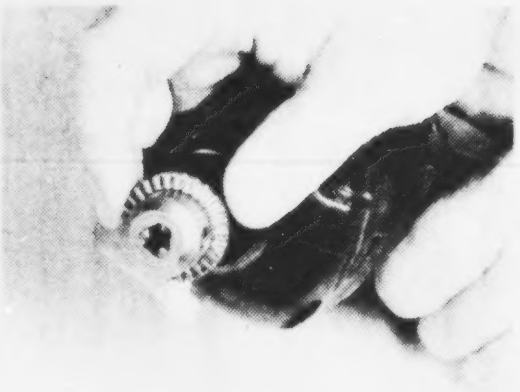


STEP 7 – The power cord is used to plug the drill into a wall outlet.

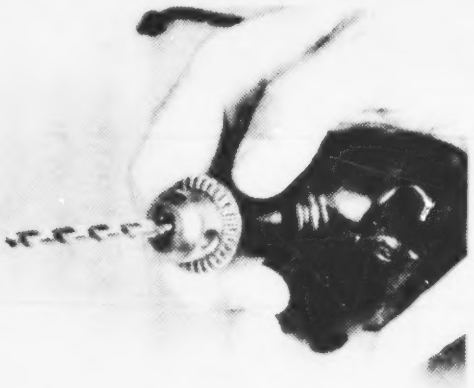
STEP 8 – REMEMBER THIS SAFETY RULE. Always wear safety glasses when using a drill.



STEP 9 – REMEMBER THIS SAFETY RULE. Always put the metal to be drilled in a vise.

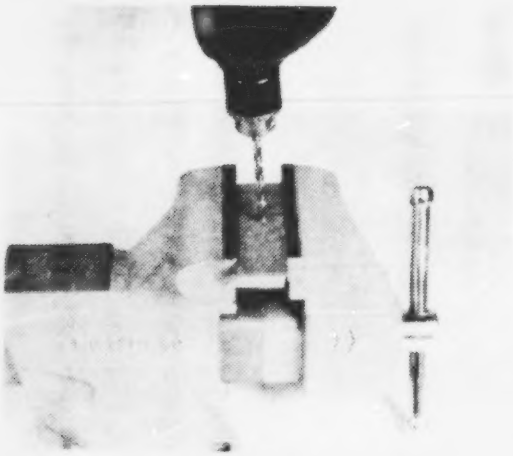


STEP 10 – To put a drill bit in a drill, the chuck may need to be loosened.



STEP 11 – Put the bit in the drill with sharp point out, then tighten chuck against the bit.

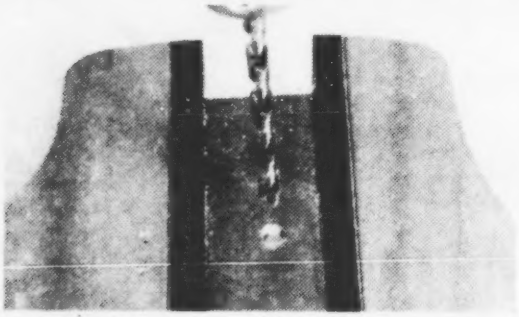
STEP 12 – Remember to remove chuck key before starting drill.



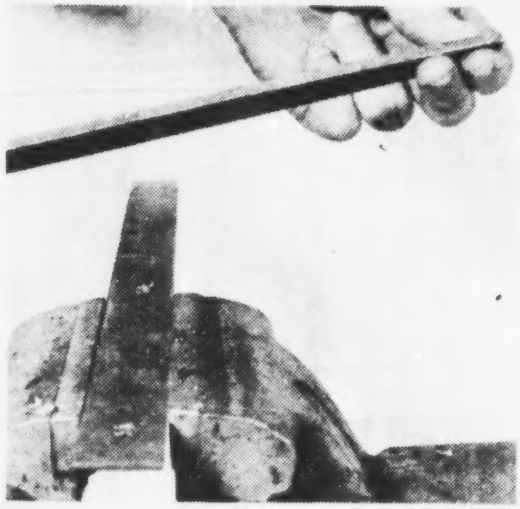
STEP 13 – Put the drill bit point against the metal to be drilled and hold the drill straight.

STEP 14 – The drill should be 90° to the metal.

STEP 15 – Drill the hole; when the bit goes through the metal, release the trigger to stop the drill.



STEP 16 – Pull the drill upward taking the bit out of the hole.

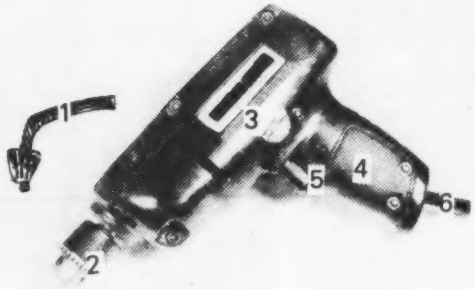


STEP 17 – There will be burrs on the bottom of the metal where the hole was drilled.
STEP 18 – Use a file to remove the burrs.

## Check Point

Identify the following parts of a power hand drill on your answer sheet.

A. Handle
B. Trigger Switch
C. Electric Cord
D. Chuck Key
E. Chuck
F. Frame




STEP 19 – When you have completed check-point, check your answers with the ones below.

A - 4
B - 5
C - 6
D - 1
E - 2
F - 3

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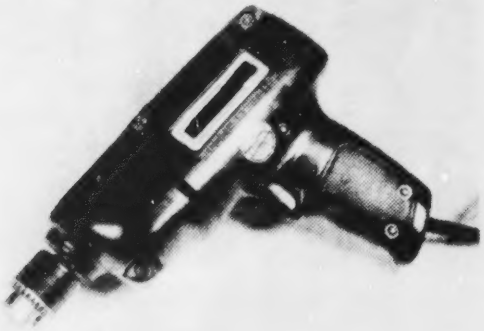
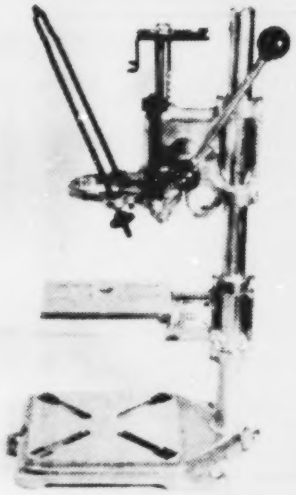
# Instructional Objective VII

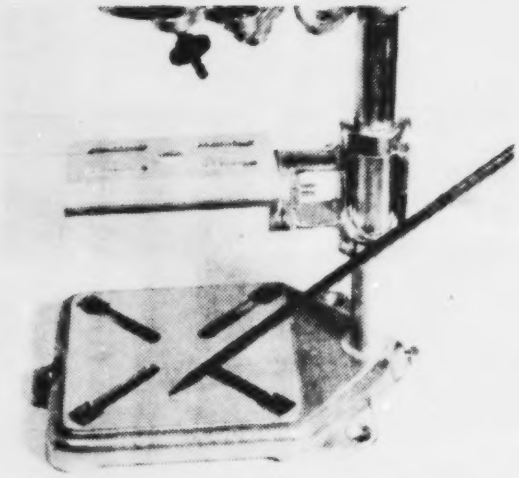
The student will identify the parts of a table mounted drill press and learn how to use it correctly.



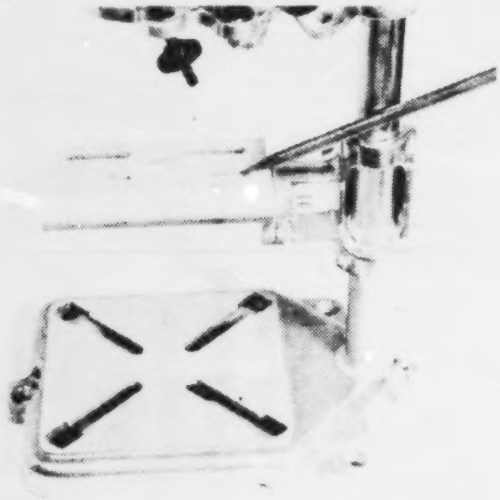
STEP 1 – The drill stand is made to hold either a ¼" (.635 cm) or 3/8" (.9525 cm) hand drill.



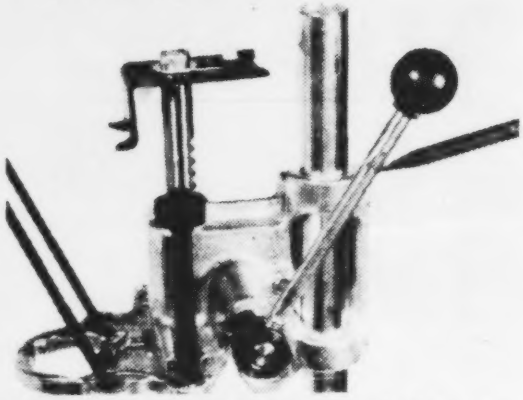
STEP 2 – There are five basic parts of the drill stand – the stand, bed, feed arm, depth gauge, and drill clamp.



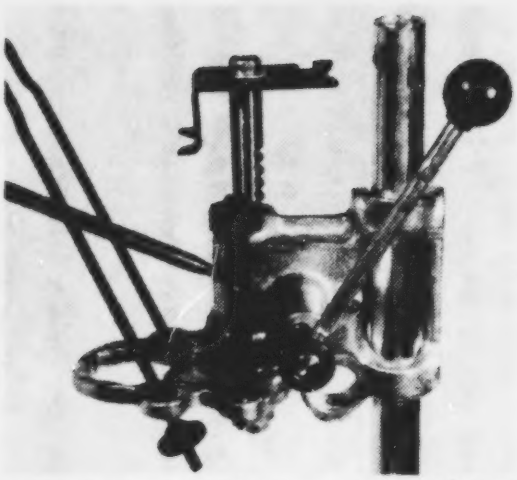
STEP 3 – The stand balances the rest of the equipment while it sits on the table.



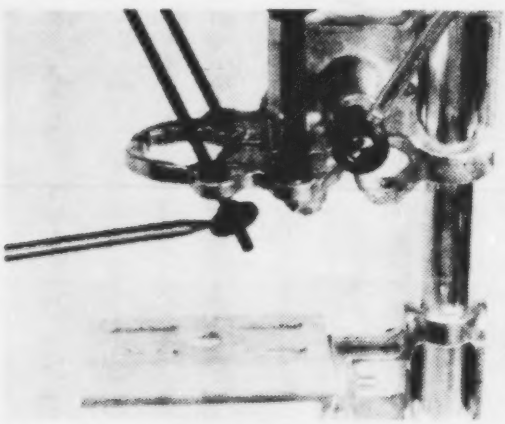
STEP 4 – The bed is where the vise is bolted and the height can be adjusted by a nut on the side near the shaft.



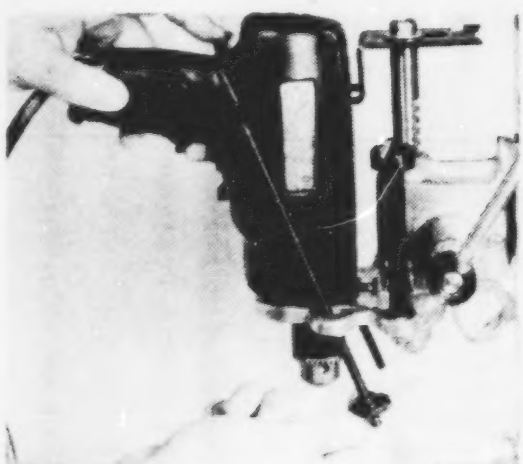
STEP 5 – The feed arm controls the up and down movement of the drill.



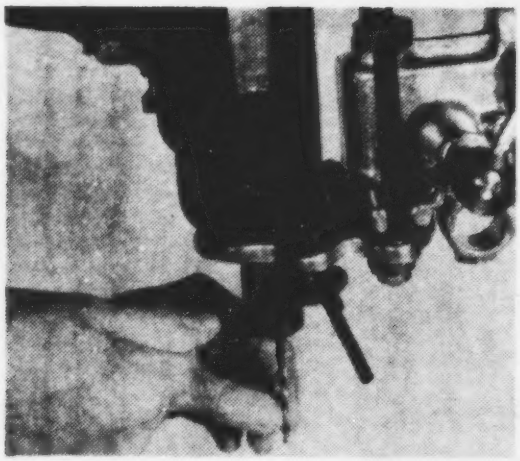
STEP 6 – The depth gauge sets the depth the drill will go down.



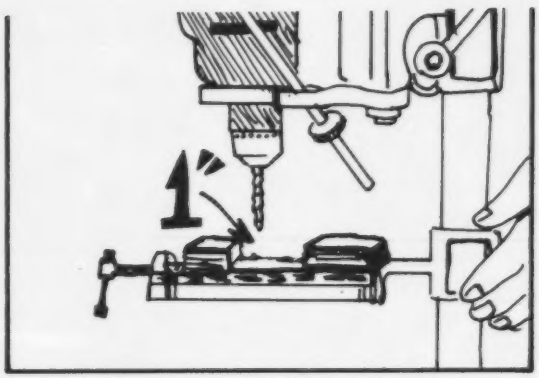
STEP 7 – The clamp for the drill is tightened by thumb screws on the bottom of the clamp.



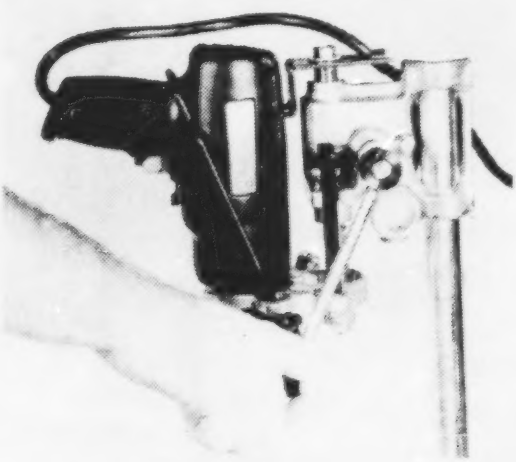
STEP 8 – Put the 3/8" (.9525 cm) drill in the drill stand. Tighten the screws.



STEP 9 – Put a bit in the drill chuck.



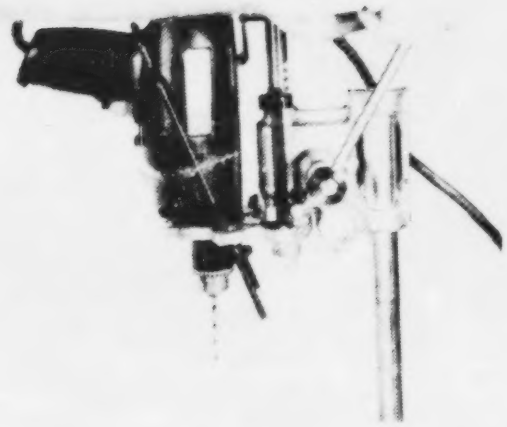

STEP 10 – Adjust bed height so that vise is about 1" (2.54 cm) below the point of the drill bit.



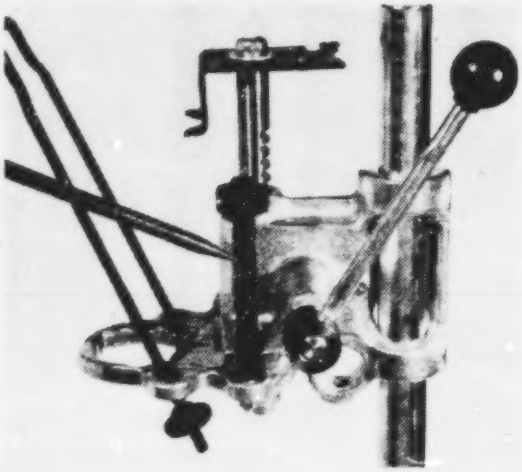
STEP 11 – Grab feed handle and pull it down gently.



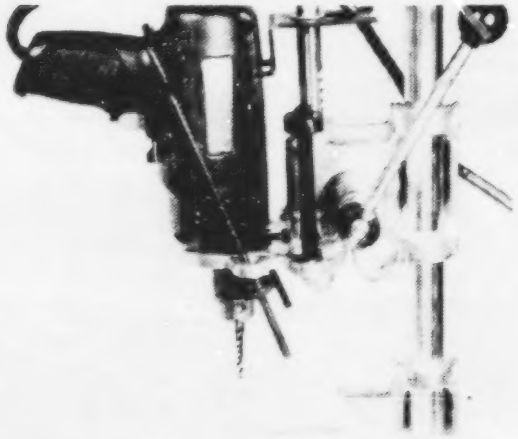
31



STEP 12 – Let the feed handle back up easily.



STEP 13 – If the depth gauge will not let the bit go down far enough to drill through a piece of metal 1" (2.54 cm) thick, adjust it lower.

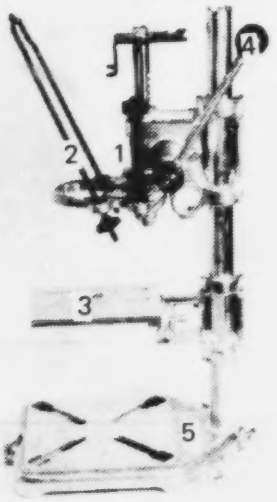


STEP 14 – You are now ready to drill a hole.

## Check Point

Match the parts of the drill stand with the correct name by placing the number in the blank on your Student Answer Sheet.

A. Bed
B. Drill clamp
C. Depth gauge
D. Feed arm
E. Stand

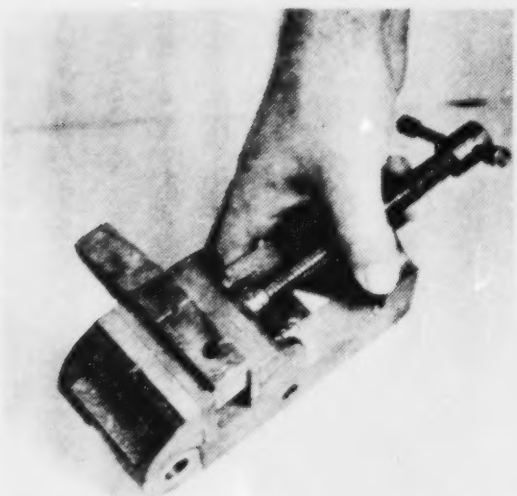



STEP 15 – When you have completed this answer sheet, check your answers.

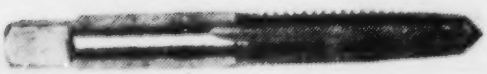
A - 3
B - 2
C - 1
D - 4
E - 5

## Instructional Objective VIII

The student will identify the parts of and use of a tap.

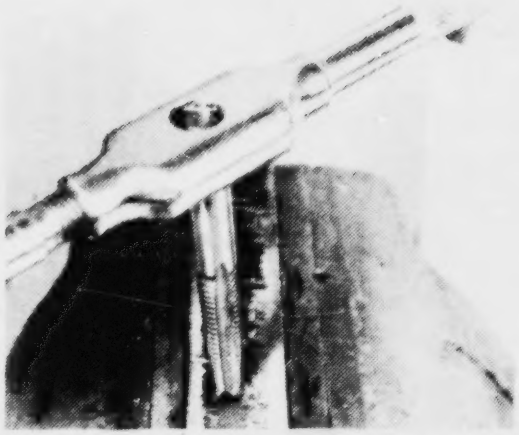


STEP 1 – Before a hole can be tapped out, it must be drilled to the correct size.

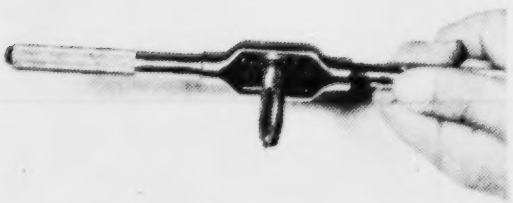


STEP 2 – The size of a tap and the hole size is always stamped on the tap.

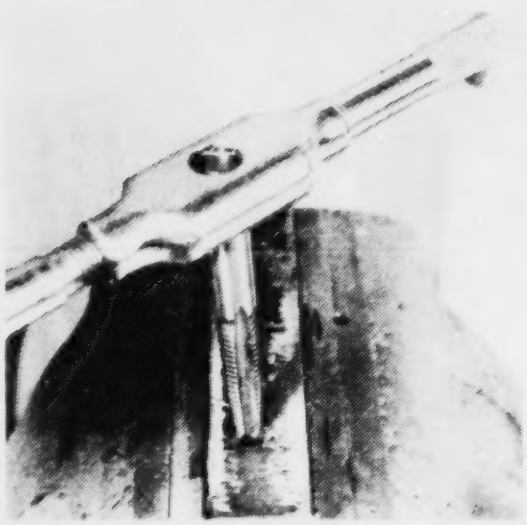
STEP 3 – For example, 3/8" - 16 NC - 5/16". This means the threads will be 3/8" with 16 threads per inch and the hole size is to be drilled 5/16 of an inch (.79375 cm).



STEP 4 – When the hole is drilled, it is smaller than the tap so the threads can be cut.



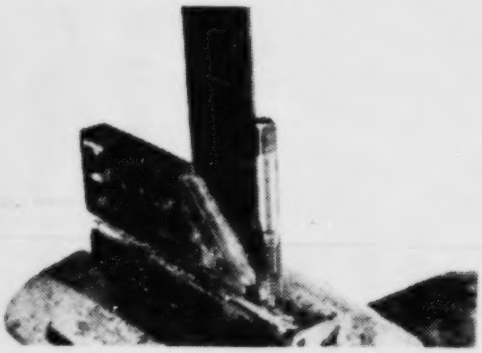
STEP 5 – Put the square end of the tap in the tap handle and tighten it.



STEP 6 – Put the point of the tap in the hole keeping it straight.

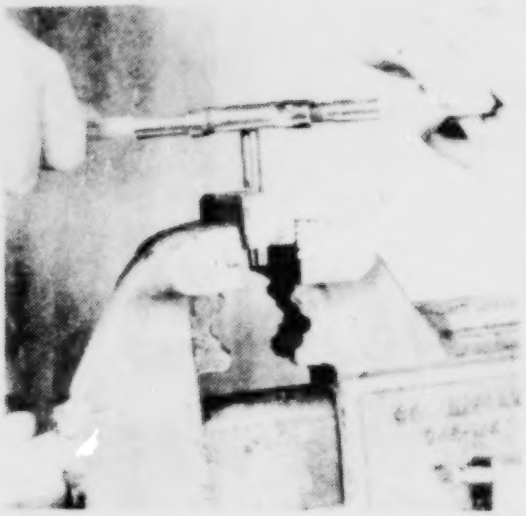
33

STEP 7 – Turn the tap in a clockwise direction.



STEP 8 – When the tap is started, check it with a square to see if it is straight.

STEP 9 – If so, continue turning the tap. For each full turn, back the tap up ¼ of a turn to break off the chips of metal in the tap.



STEP 10 – Continue this procedure until the hole is threaded all the way through.

STEP 11 – Remove the tap and lay it down.

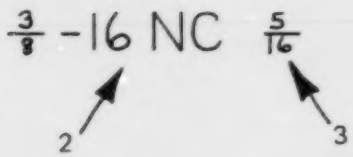
34

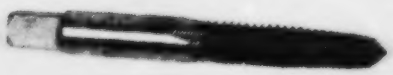
## Check Point

Match the parts of the tap with the correct name by placing the number in the blank on your student Answer Sheet.

A Tap
B Size hole to drill
C Size threads per inch
D Tap handle

1



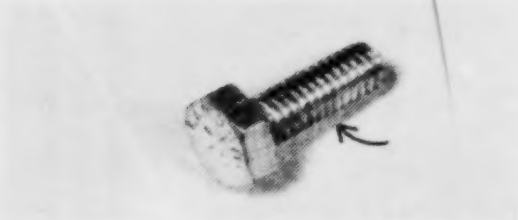
4

STEP 13 – When you have completed the identification, check your answers.

A - 4
B - 3
C - 2
D - 1

## Instructional Objective IX

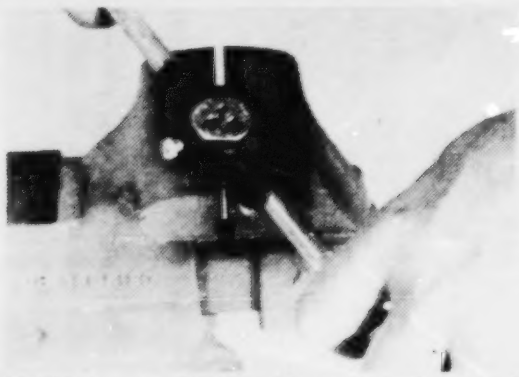
The student will identify the parts of and the use of a die.



STEP 1 – The die cuts outside threads.

STEP 2 – The die is circular in shape with a hole in the center.

STEP 3 – In this hole is where the teeth that cut the metal are located.



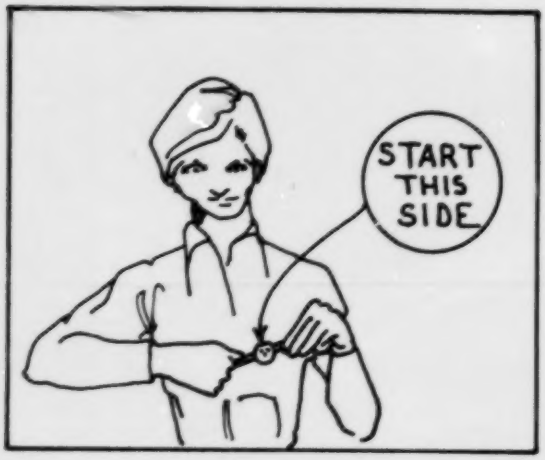
STEP 4 – A die is made to thread a certain size shaft.

35

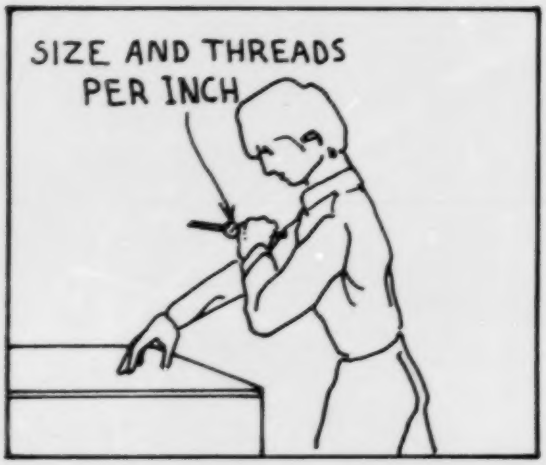
STEP 5 – If too large, it will not start.

STEP 6 – If too small, the threads will give a loose fit.

STEP 7 – The die fits in the handle and is locked in with 3 set screws or one lock bolt.

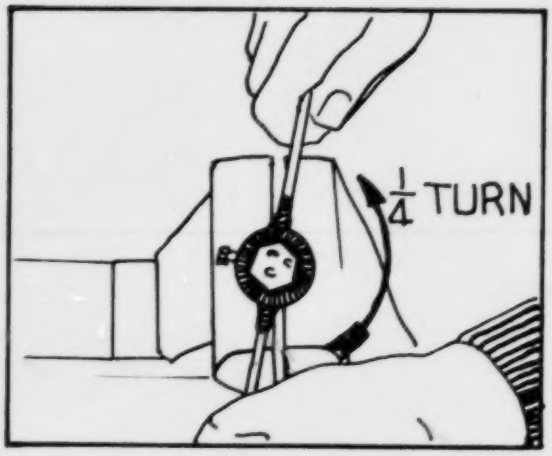



STEP 8 – Look at the die, one side says start this side.




STEP 9 – The other side gives size and threads per inch.

STEP 10 – Start the die by turning in a clockwise direction.




STEP 11 – For every full turn of the die, back up ¼ turn to break off chips.

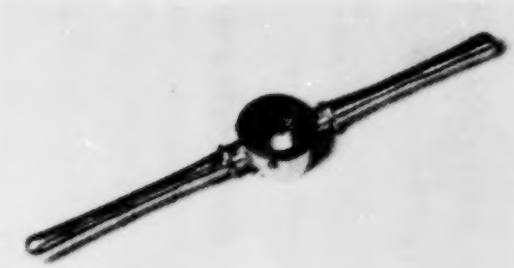
STEP 12 – When threads are as far as needed, reverse the direction of the die and back it off and lay it down.



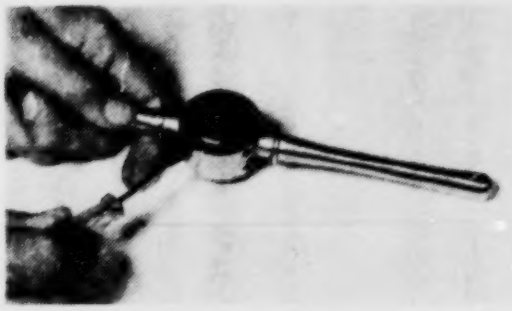
30

## Check Point

A. Die
B. Die handle
C. Lock screw
D. Size die



1.



2.

3.

4.

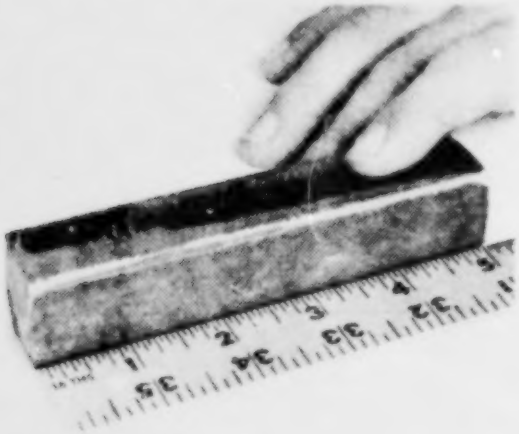
STEP 13 – When you have completed this objective, check your answers. A - 3, B - 1, C - 2, D - 4.

### INTRODUCTION

This section will be concerned with measuring, cutting, drilling, tapping threads, using a die to cut threads, and putting together an adjustable C-Clamp. In the sequential instruction, follow each step in order.

## Instructional Objective X

The student will measure and cut stock.



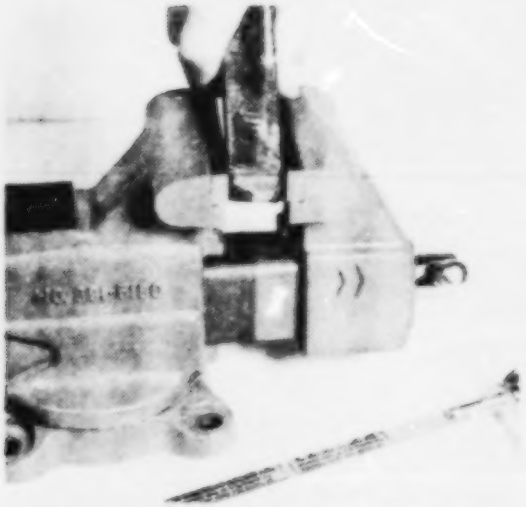
STEP 1 – Using the rule, measure a piece of ¾" x 1" (1.905 cm x 2.54 cm) rectangular metal 4" (10.16 cm) long and mark it.

STEP 2 – Using the square, line it up on the mark at 4" (10.16 cm), scribe a mark across the metal.

STEP 3 – Place the metal in the vise with the line on top and place the line as close to the vise as possible without cutting the vise with the saw.

STEP 4 – Place the saw on the mark.

STEP 5 – Cut the metal. Lay the saw down.



STEP 6 – Take the metal out of the vise.

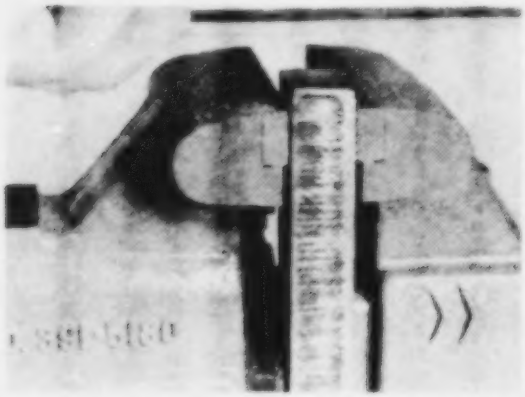
STEP 7 – Mark another piece of ¾" x 1" (1.905 cm x 2.54 cm) rectangular metal 4" (10.16 cm) long.
STEP 8 – Repeat steps 2, 3, 4, 5, and 6.

## Check Point

Check each end of the metal with a square to see that it is cut square. If not, put the metal back in the vise with the end sticking up about ½" (1.27 cm) above the vise.

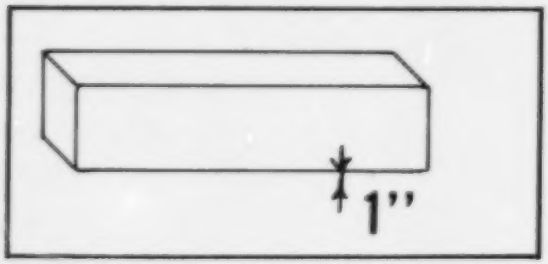
# Instructional Objective XI

The student will file, measure, and cut jaws of the clamp.

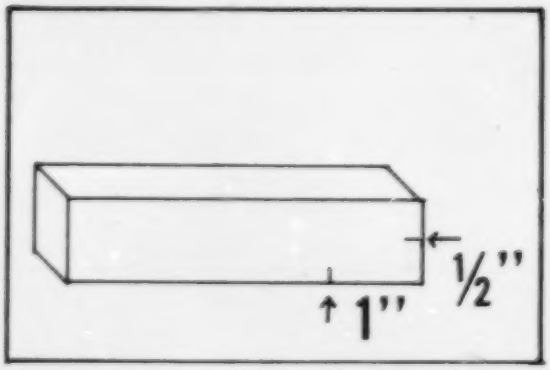


STEP 1 – Pick up the file and file the end of the piece of metal until it is square. Refer to Objective IV on filing.

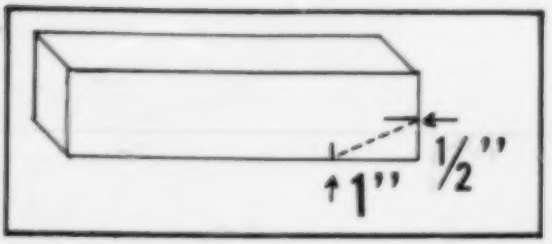
STEP 2 – Repeat Step 1 on the other 3 ends of the 2 pieces of metal.



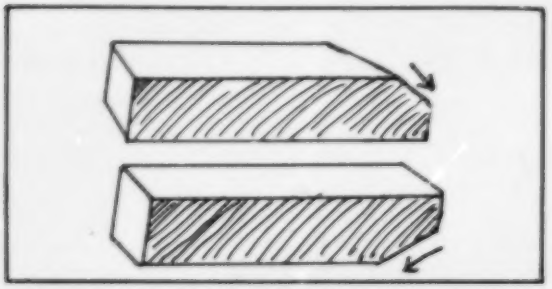

STEP 3 – Pick up one of these pieces of metal and measure from one end 1"(2.54 cm) and mark.



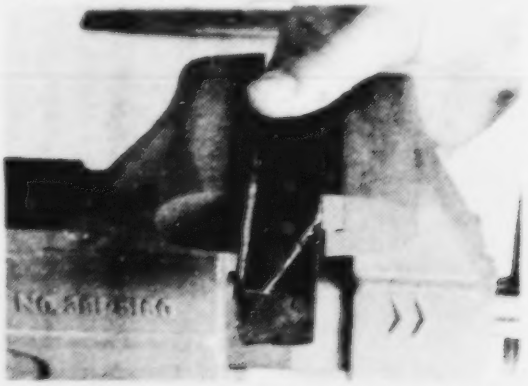

STEP 4 – On the same end measure over ½" and mark it.




STEP 5 – Using the rule for a straight edge, scribe a mark from the first mark to the second.

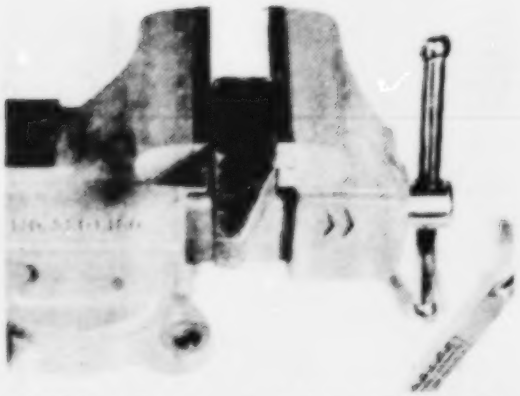


STEP 6 – Repeat Steps 3, 4, and 5 on the second piece of metal.



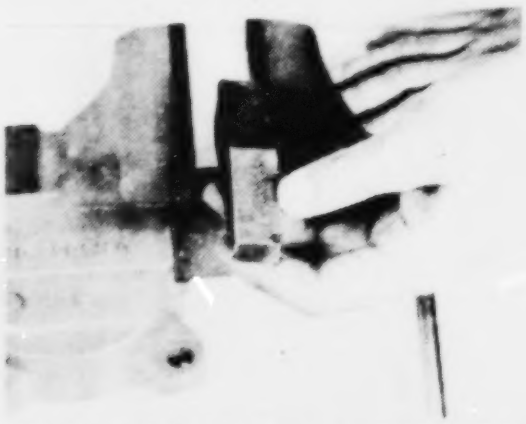
STEP 7 – Place one piece in the vise with the mark facing up. Locate the metal so the line is outside the jaws of the vise and tighten securely.

STEP 8 – Pick up hack saw and put the blade on the line.



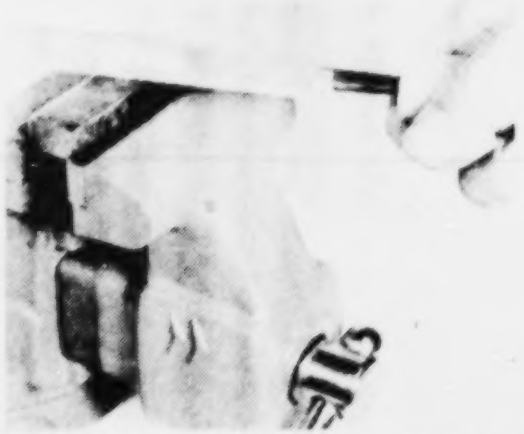
STEP 9 – Cut the metal along this line. When cut is completed, lay saw down.

STEP 10 – Repeat Steps 7, 8, and 9 to the second piece of metal.



STEP 11 – Take the piece of metal out of the vise and turn it with the cut part facing up.

STEP 12 – Put it back in the vise with the cut part up and tighten securely.



STEP 13 – Pick up the file and file the cut smooth and flat. Remove this piece from the vise.

STEP 14 – Pick up the other piece of metal with the cut facing up and put it in the vise.

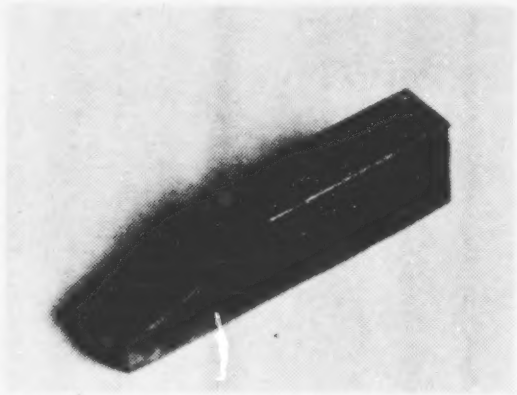
STEP 15 – Repeat Step 13.

## Check Point

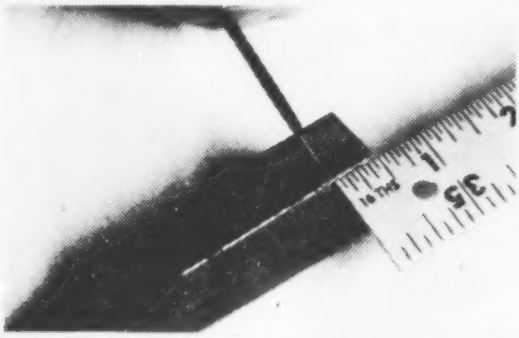
Are both pieces equal in size? If not, make the larger piece match the smaller piece.

## Instructional Objective XII

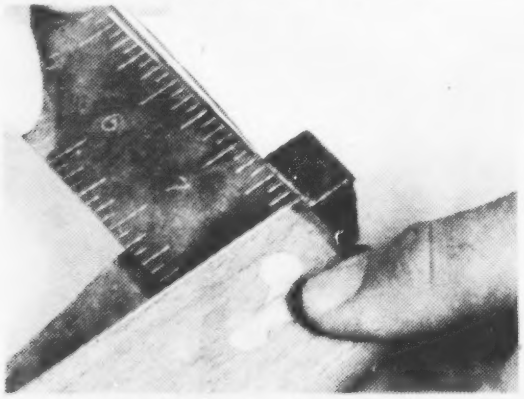
The student will measure and mark the holes for drilling.



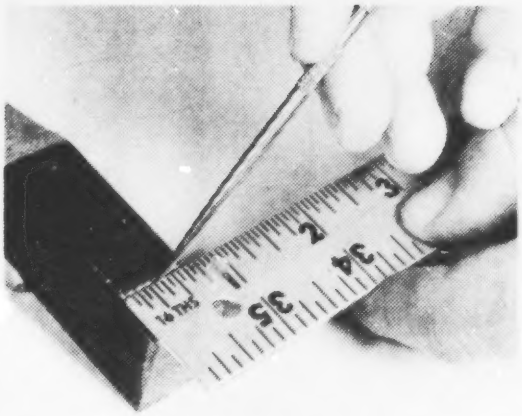
STEP 1 – Pick up one of the pieces of metal and put it on the table with the cut edge facing up.



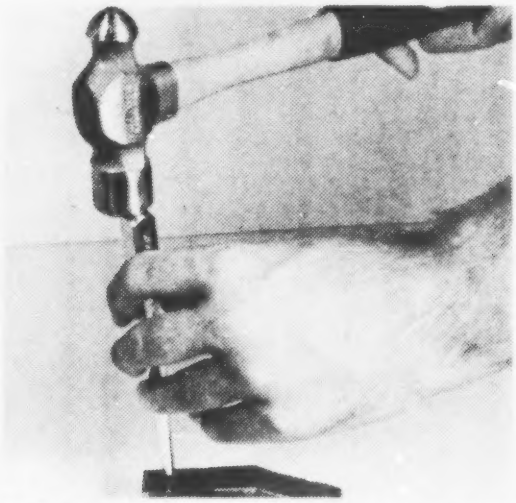
STEP 2 – Pick up the metal rule and from the opposite end of the cut, measure in ½" (1.27 cm) and put a mark.



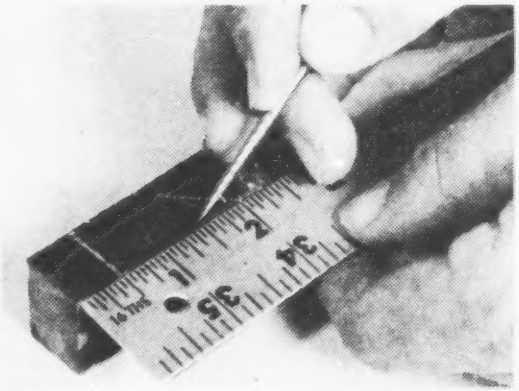
STEP 3 – Using the square, scribe a mark across the metal at this point.



STEP 4 – Take the rule and measure in from the side 3/8" (.9525 cm) on the line and put a mark. This locates the center of the metal.



STEP 5 – Pick up the ball peen hammer and punch. Punch the metal where these marks cross. This locates the center of the first hole.



STEP 6 – Using the rule, measure from the same end in 1½" (3.81 cm) and put a mark.

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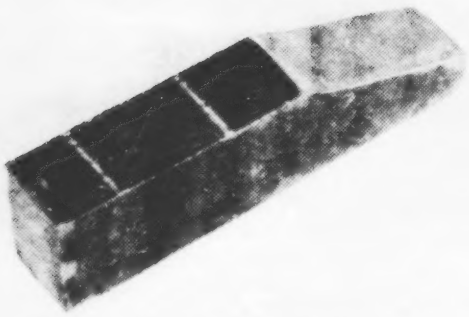
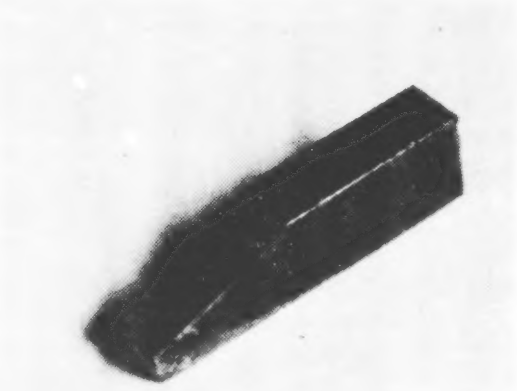
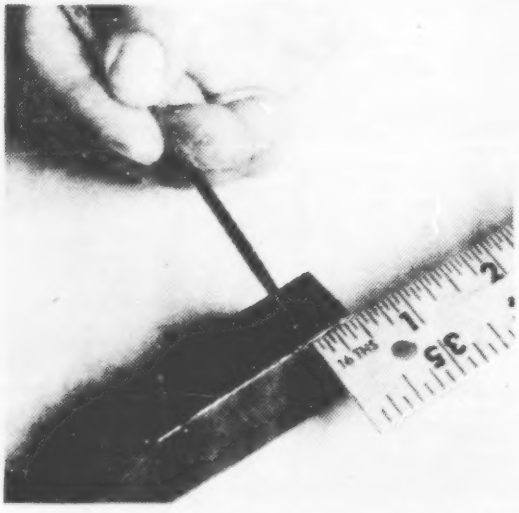


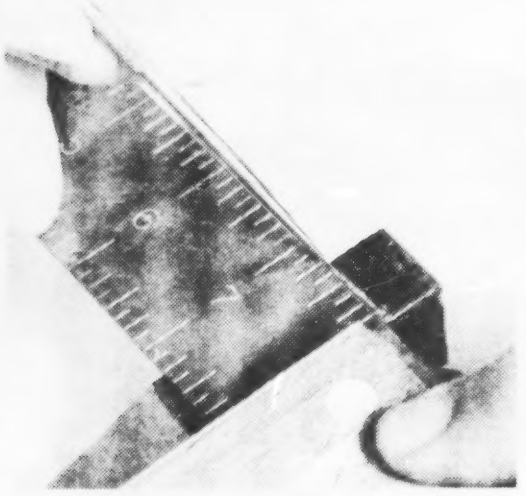
STEP 7 – Repeat Steps 3, 4, and 5. This locates the second hole.



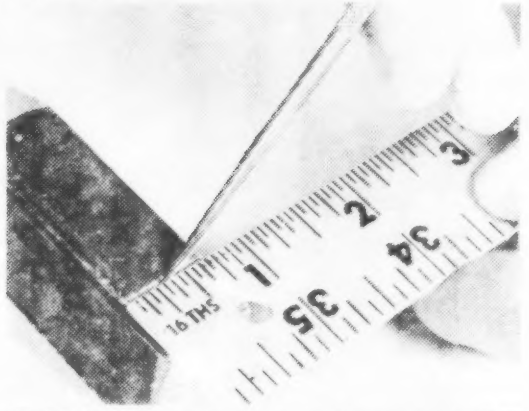
STEP 8 – Place the second piece of metal on the table with the cut edge facing up.



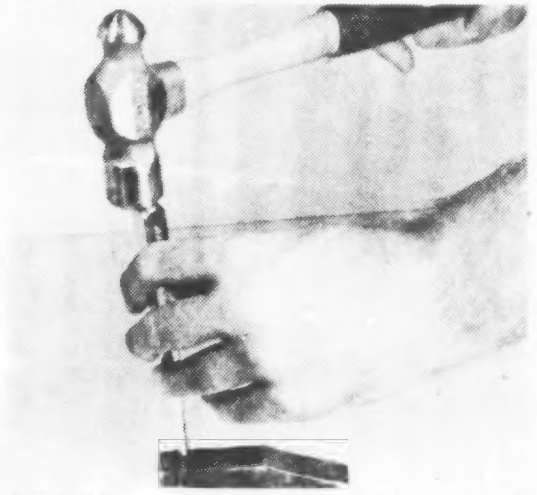
STEP 9 – Pick up metal rule and from opposite end of the cut, measure in ½" (1.27 cm). Put a mark.



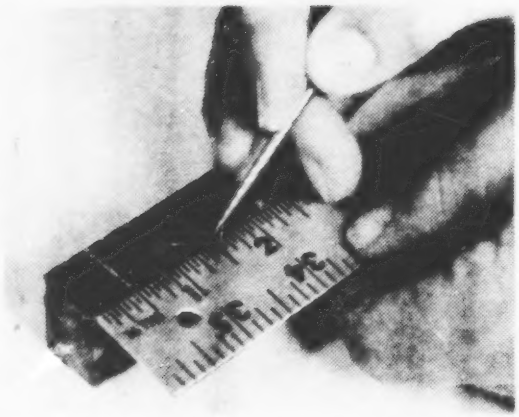
STEP 10 – Using the square, scribe a mark across the metal at this point.



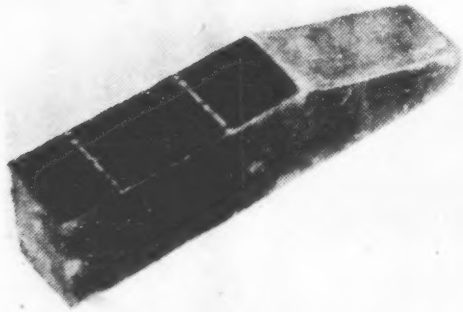
STEP 11 – Take the rule and measure in 3/8" (.9525 cm) on the line and put a mark. This locates the center of the metal.



STEP 12 – Pick up the ball peen hammer and center punch. Punch the metal where these marks cross. This locates the center of the first hole.



STEP 13 – Using the rule measure from the same end in 1½" (3.81 cm) and put a mark.



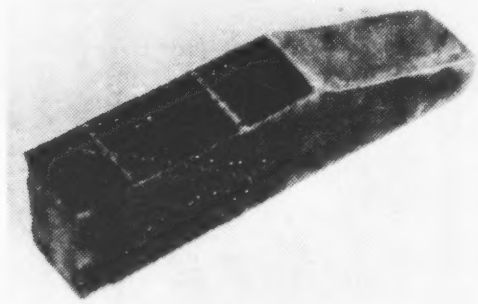
STEP 14 – Repeat Steps 3, 4, and 5. This locates the second hole.

## Check Point

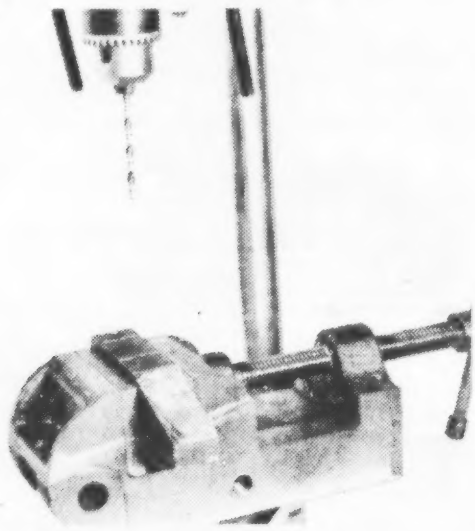
Are all the holes even on both pieces of metal? If they are, proceed to the next Instructional Objective. If not, repeat the last objective.

## Instructional Objective XIII

The student will center drill four holes 1/8" (.32 cm) and then redrill the holes 5/16" (.79 cm) and 3/8" (.95 cm).

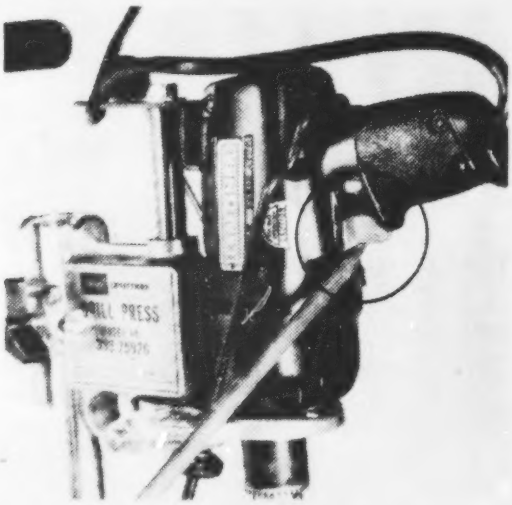


STEP 1 – Put one of the pieces of metal in the vise on the drill press with the marks pointing up and the metal squared to the bit.

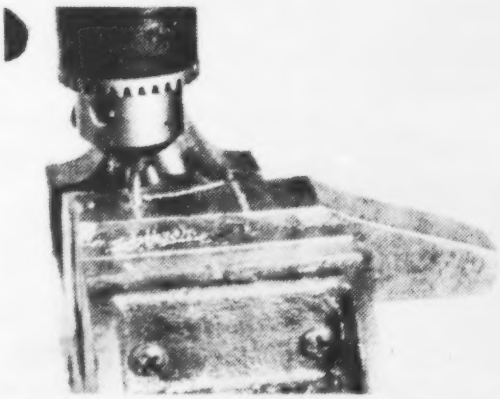


STEP 2 – Using the mark closest to the end of the metal, put the point of the 1/8" drill bit in the punch mark.

STEP 3 – Remember all safety rules which go along with the drill press. Review if needed.

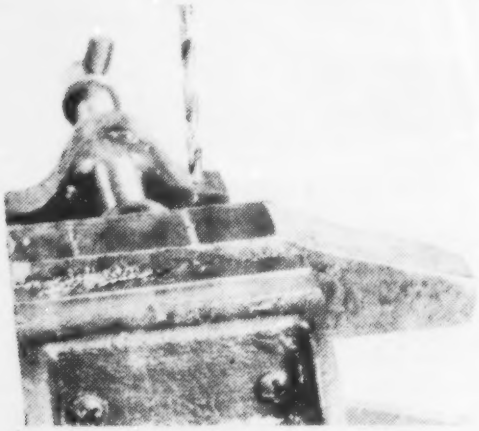


STEP 4 – Grab handle of drill press and turn on drill.

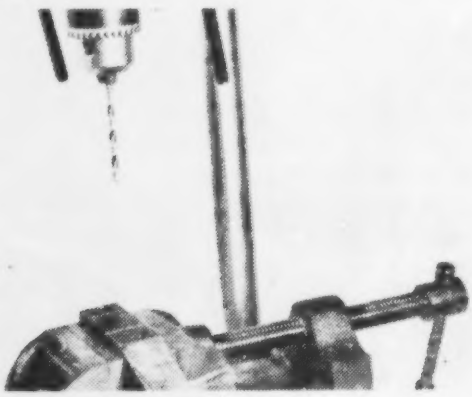


STEP 5 – Drill hole through the metal by pulling down on one arm of drill press.

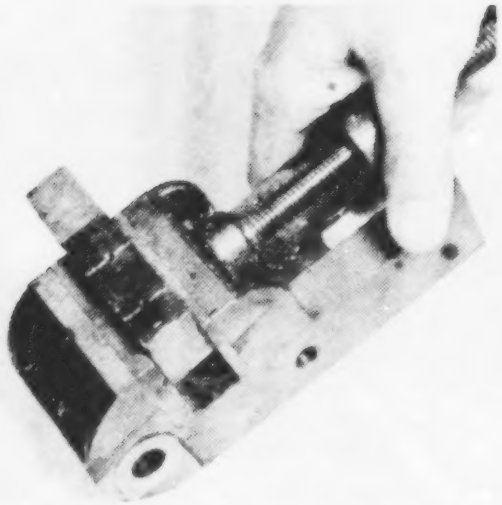
STEP 6 – Let drill handle back up slowly and cut off machine.



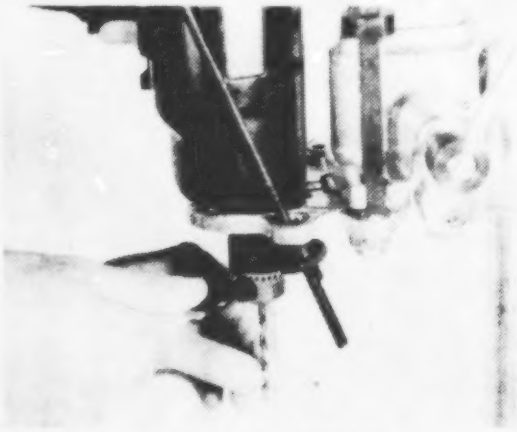
STEP 7 – Drill two marks on metal with 1/8" bit.



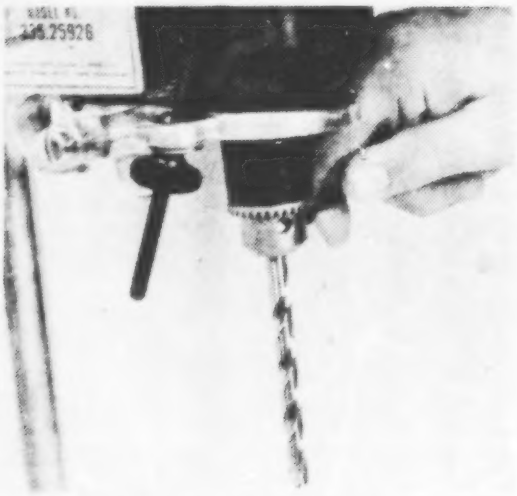
STEP 8 – Put the second piece of metal in the vise on the drill press, with the marks pointing up.



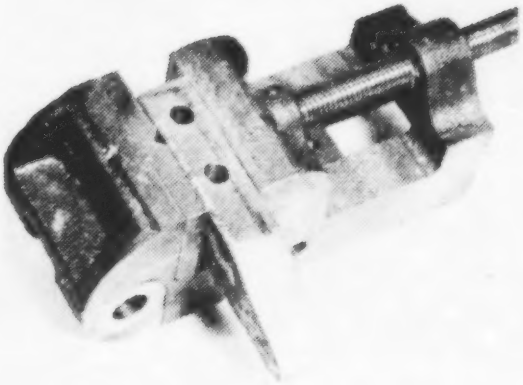
STEP 9 – Repeat steps 2 – 6 to drill 2 holes 1/8".



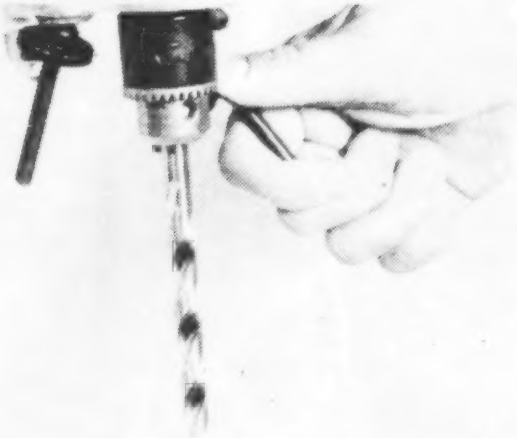
STEP 10 – Remove 1/8" drill bit



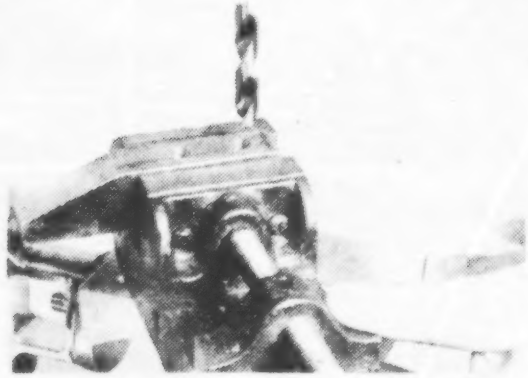
STEP 11 – Put in 5/16" drill bit.



STEP 12 – Drill all four 1/8" holes with 5/16" bit.



STEP 13 – Remove the 5/16" drill bit and replace it with a 3/8" drill bit.



STEP 14 – Using the hole closest to the end of the metal, drill one hole 3/8".



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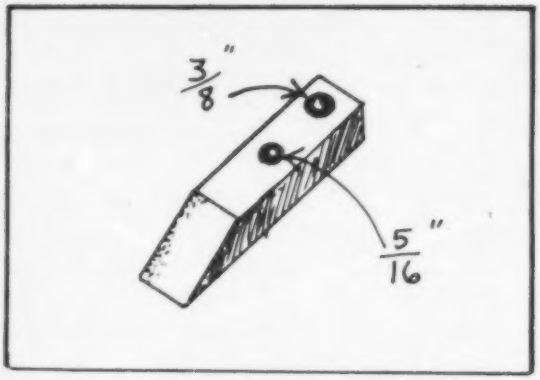
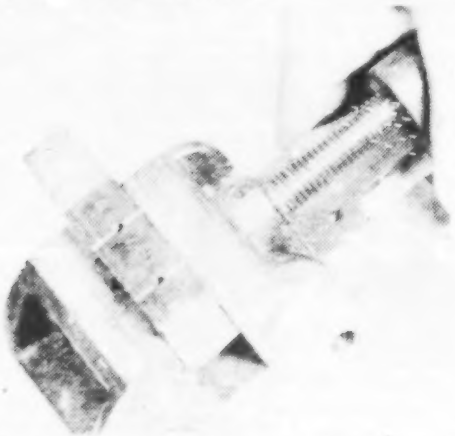
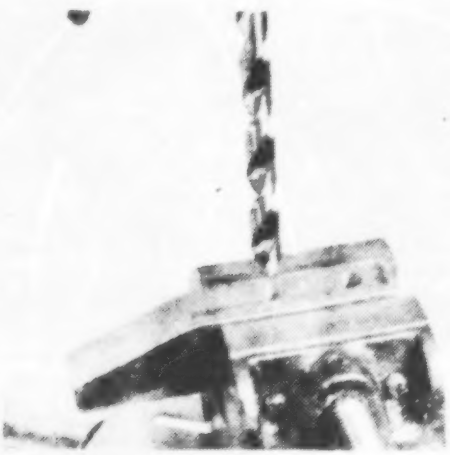


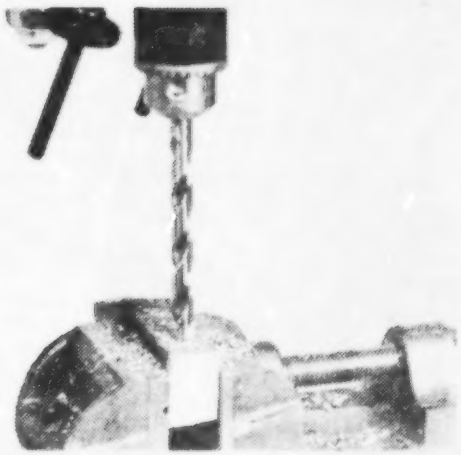

STEP 15 – Remove this piece of metal from the vise. It should have 2 holes drilled through it; One 5/16" and one 3/8".



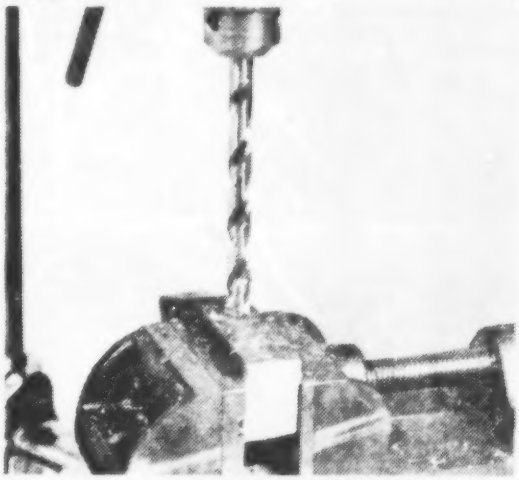
STEP 16 – Place second piece of metal in the vise.



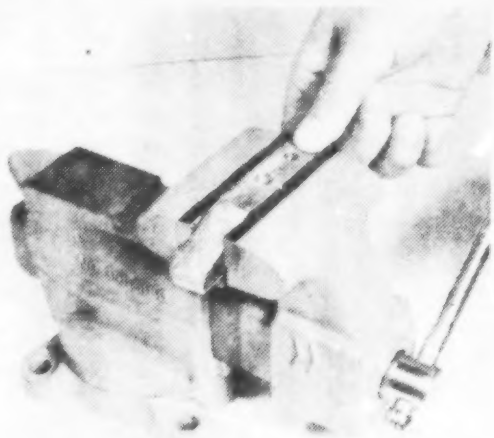
STEP 17 – Line up the 5/16" hole that is 1½ inches (3.81 cm) from the end of the metal.



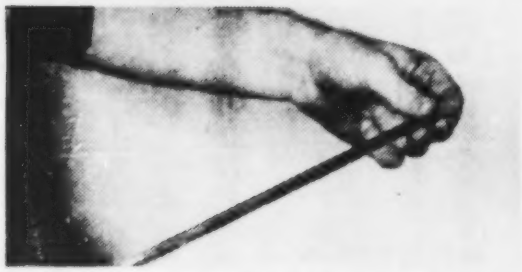
STEP 18 – Drill a 3/8" hole through the metal.



STEP 19 – Remove metal from vise and turn the metal over. See burrs on bottom of each hole.



STEP 20 – Put it in vise with the burrs pointing up.



STEP 21 – Using the file, remove the burrs.

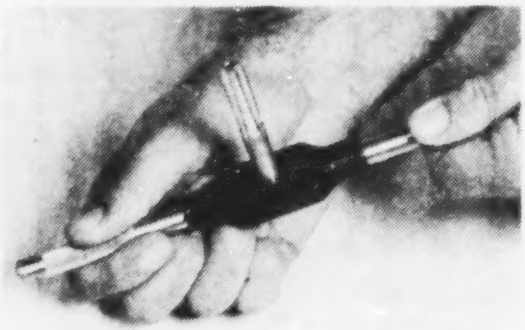
## Check Point

Are all the drilled holes free of burrs? If they are, proceed to the next Instructional Objective.

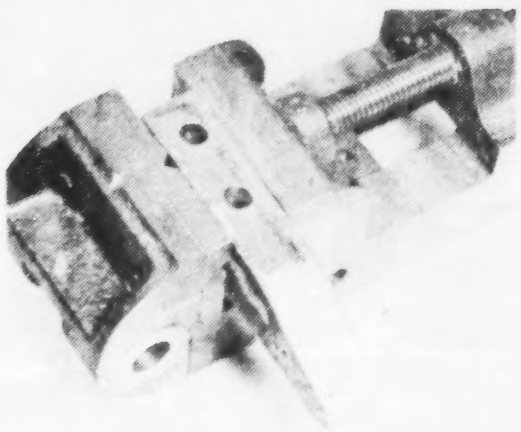
## Instructional Objective XIV

The student will tap a 3/8" (.9525 cm) thread in each of the 5/16" (.79375) holes of the clamp jaws.

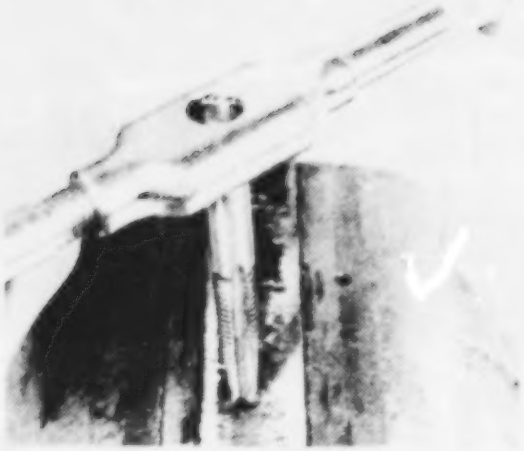
STEP 1 – Take the 3/8-16 tap and handle out of the kit.



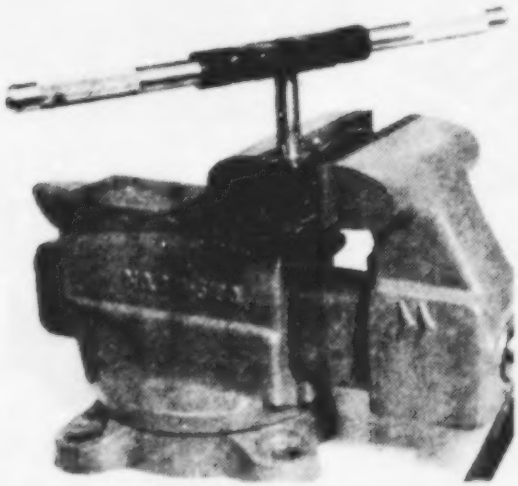
STEP 2 – Put the tap in the handle.



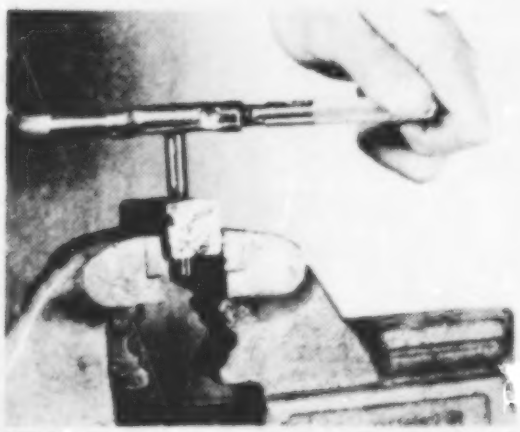
STEP 3 – Put the metal in the vise with the holes facing up.



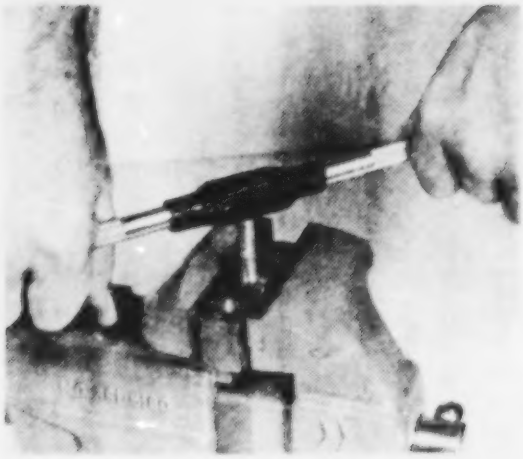
STEP 4 – Set point of tap in the 5/16 hole.



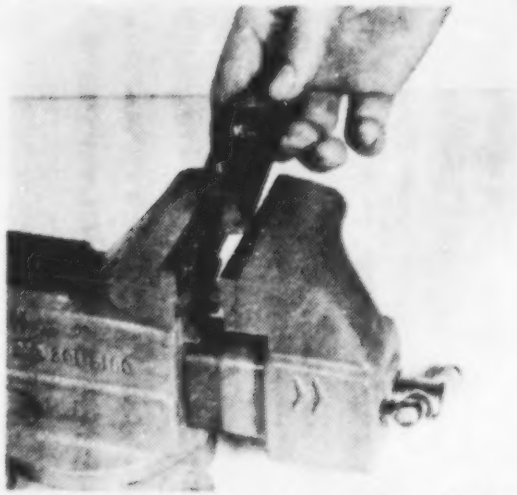
STEP 5 – Start the tap making sure it is straight.



STEP 6 – Continue turning the tap into the metal until the threads are all the way through.



STEP 7 – Back the tap out.



STEP 8 – Take this piece of metal out of the vise and put the other piece in with the holes facing up.

STEP 9 – Repeat Steps 4,5,6, and 7.

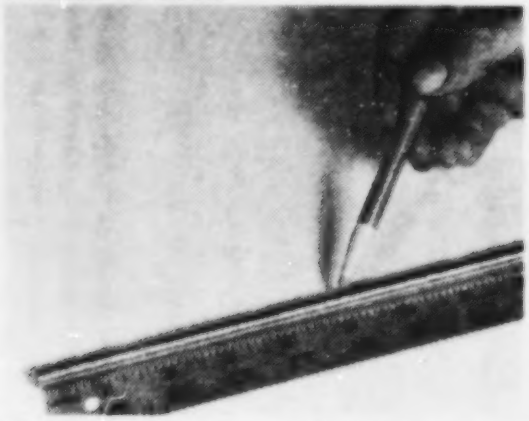
STEP 10 – Take this piece of metal out of the vise.

## Check Point

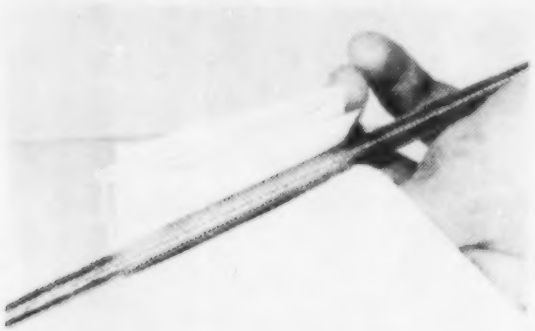
Make sure the threads are neat and clean. Remove all excess metal.

## Instructional Objective XV

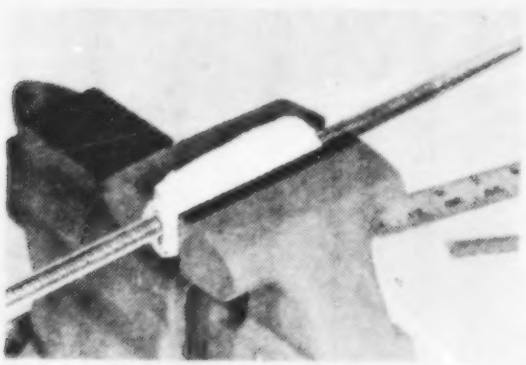
The student will cut two pieces of threaded rod stock.

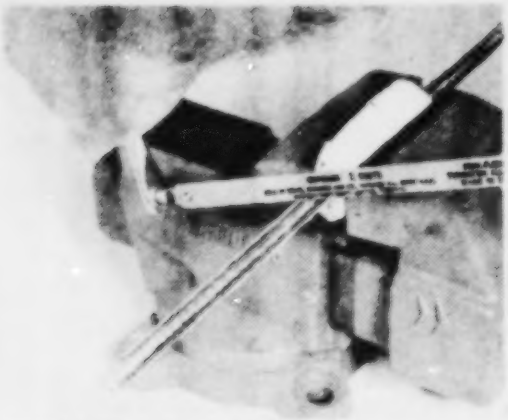


STEP 1 – Get a piece of 3/8 threaded rod and measure 5" (12.7 cm). Make a mark.

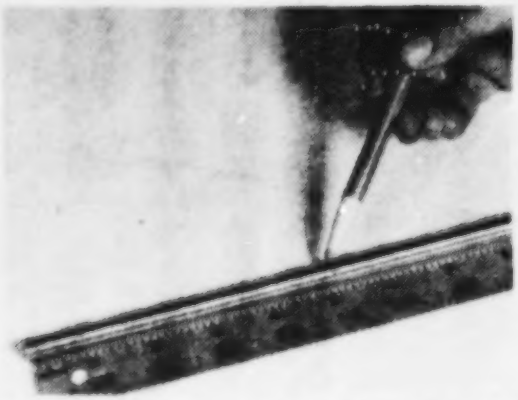


STEP 2 – Wrap metal rod in paper to protect the threads from being damaged by the jaws of the vise.





STEP 4 – Cut rod at mark.



STEP 5 – Measure another 3/8" rod 5" (12.7 cm) and mark it.

STEP 6 – Repeat steps 2, 3, and 4.

STEP 7 – File smooth the four ends of these two rods.

## Check Point

Are both pieces equal?

If so, proceed to the next Instructional Objective.

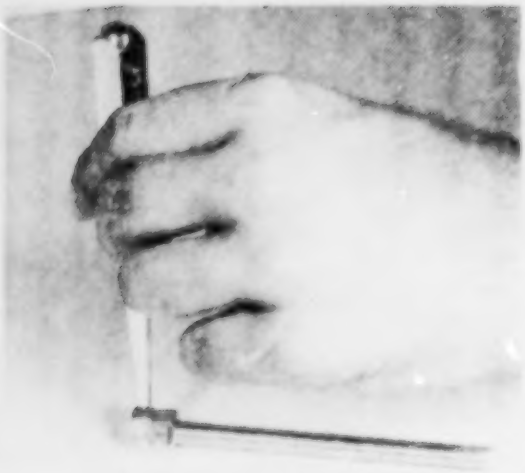
# Instructional Objective XVI

The student will drill a hole through both end nuts on the threaded stock.

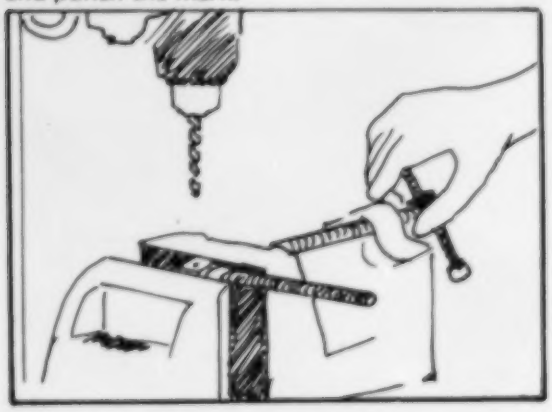
STEP 1 – Put 2 (two) 3/8 - 16 nuts on each of the pieces of rod. With both nuts on one end and threaded in together tight, flush with the end of the rod.

STEP 2 – Get the center punch and hammer.

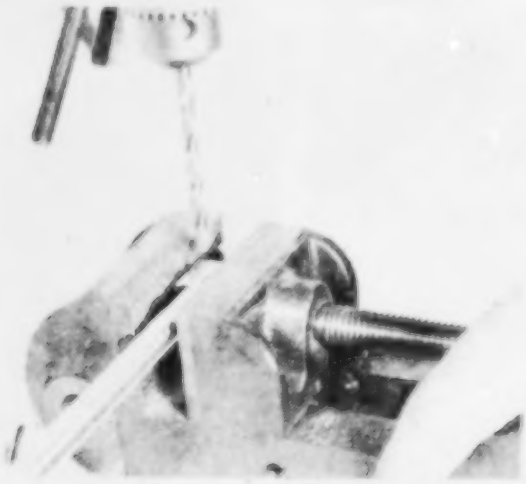
STEP 3 – On one of the flat sides of the end nut, mark the center of the nut.



STEP 4 – Put the center punch on the mark and punch the mark.



STEP 5 – Tighten the nuts with punch mark up in the vise on drill press.



STEP 6 – Line the punch mark and the point of the 3/16" (.47625 cm) drill bit up.

STEP 7 – Drill the hole through the nut and rod.

STEP 8 – Take the nut out of vise and turn it over and file off the burrs.
STEP 9 – Repeat Steps 5, 6, 7, and 8 for the other rod and nuts.

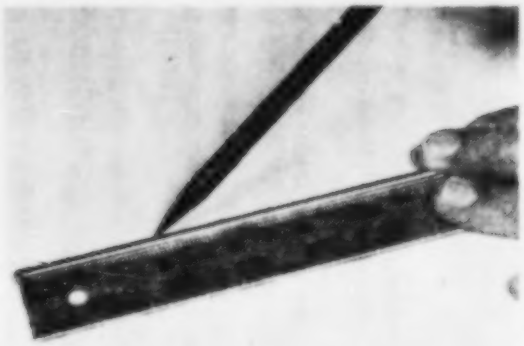
## Check Point

Have you drilled holes through both end nuts?

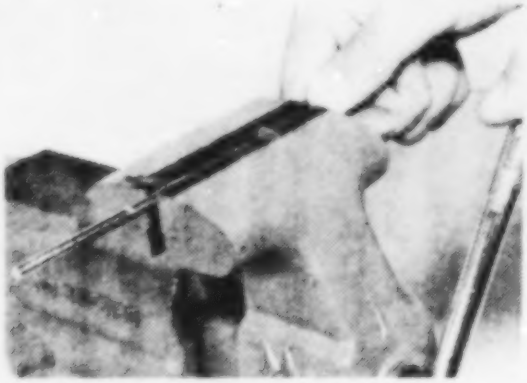
If so, go on to the next Instructional Objective.

## Instructional Objective XVII

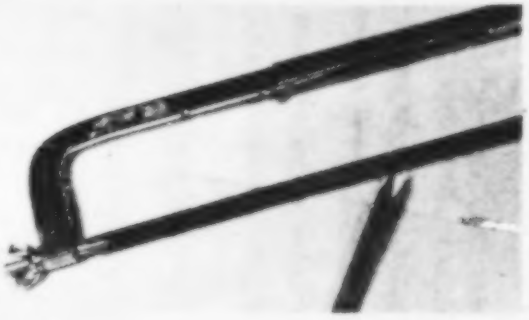
The student will cut 2 pieces of 3/16" (.47625 cm) rod 2" (5.08 cm) long.



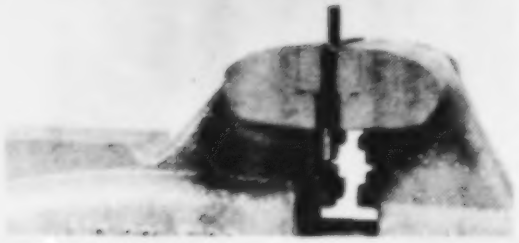
STEP 1 – Measure a piece of 3/16" (.47625 cm) rod 2" (5.08 cm) long. Put a mark.



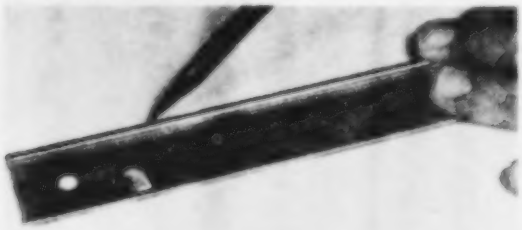
STEP 2 – Put the rod in the vise with the rod sticking out the side.



STEP 3 – Pick up hack saw and put it on the 2" (5.08 cm) mark.



STEP 4 – Cut the rod and turn it in the vise so the burrs can be filed off.



STEP 5 – Measure another 2" (5.08 cm) piece of 3/16" (.47525 cm) rod.

STEP 6 – Repeat Steps 1, 2, 3, and 4.

## Check Point

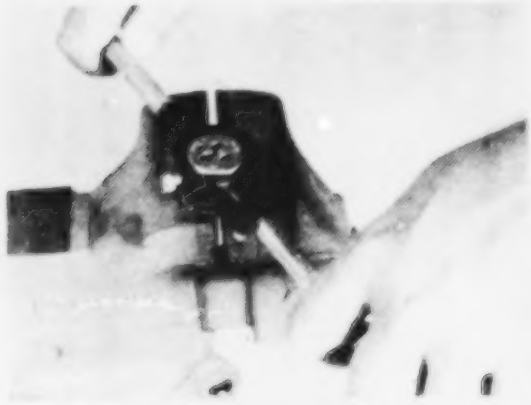
Are both pieces equal?

If so, proceed to the next Instructional Objective.

## Instructional Objective XVIII

The student will die threads on the 3/16" (.476 cm) rod stock.

STEP 1 – Put one of the pieces of 3/16" rod in the vise with the end sticking up.



STEP 2 – Start the die on this rod keeping it level.

STEP 3 – Thread this rod ½" (1.27 cm). Turn it over and thread the other side ½" (1.27 cm) long.

STEP 4 – Wrap the threads of the rod in a piece of cloth or paper to protect them from the jaws of the vise.

STEP 5 – Take the rod out and put the second rod in the vise. Repeat Steps 2, 3, and 4.

STEP 6 – Put a 12-24 nut on one end of each rod and tighten it.

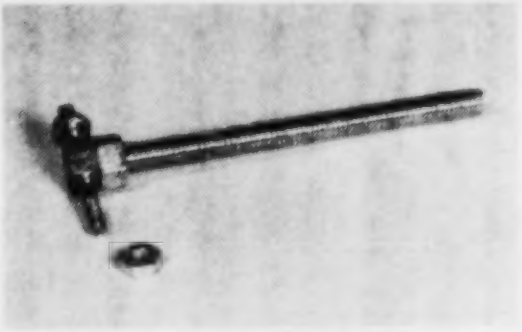
## Check Point

Are the nuts tight?

If so, proceed to the final Instructional Objective.

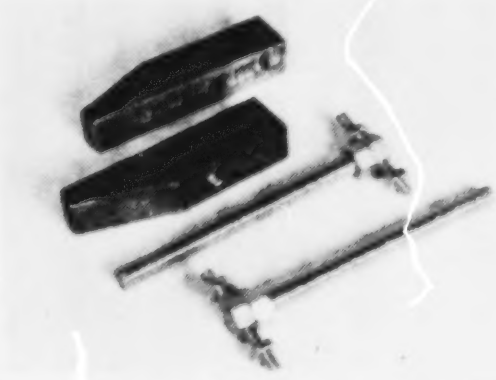
## Instructional Objective XIX

The student will assemble the parts of the C-clamp.

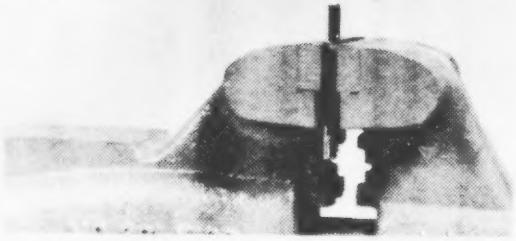


STEP 1 – Slip the 3/16" (.47625 cm) rod through the hole that was drilled through the 3/8 nut and rod.

STEP 2 – Put a 12-24 nut on the other end of the rod. This is the tightening handle for the C-clamp.



STEP 3 – Repeat Step 2 to the other 3/16" (.47625 cm) rod.



STEP 4 – Cut the rod and turn it in the vise so the burrs can be filed off.

STEP 5 – Measure another 2" (5.08 cm) piece of 3/16" (.47525 cm) rod.

STEP 6 – Repeat Steps 1, 2, 3, and 4.

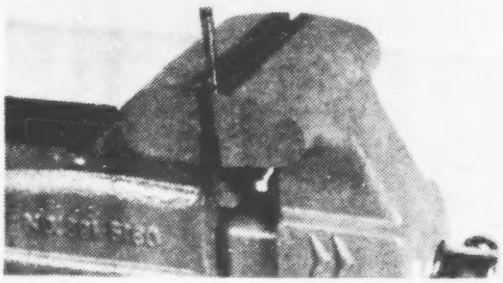
## Check Point

Are both pieces equal?

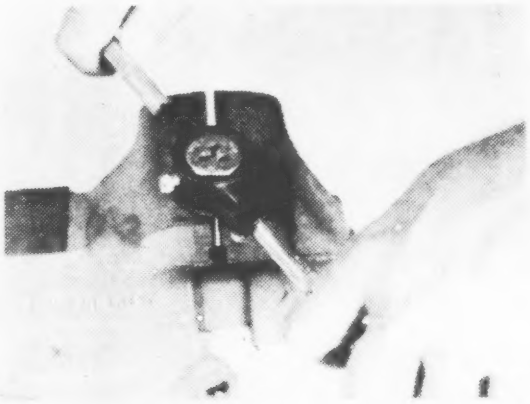
If so, proceed to the next Instructional Objective.

## Instructional Objective XVIII

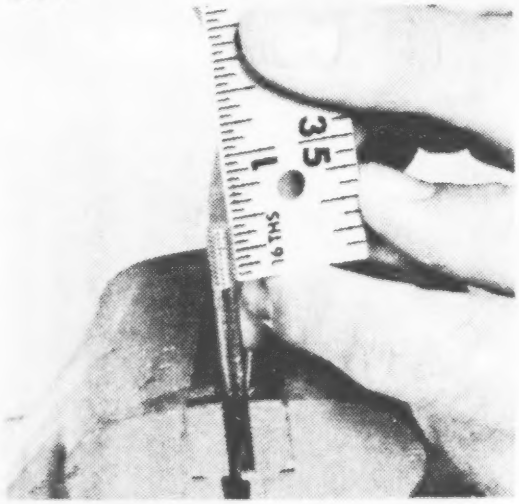
The student will die threads on the 3/16" (.476 cm) rod stock.



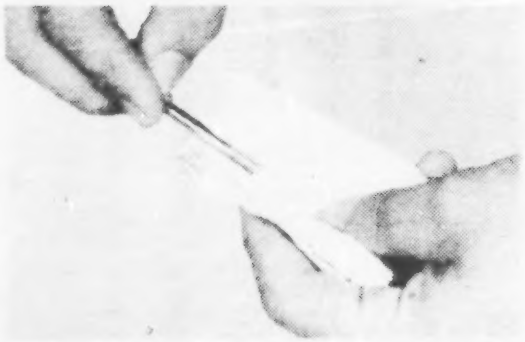
STEP 1 – Put one of the pieces of 3/16" rod in the vise with the end sticking up.



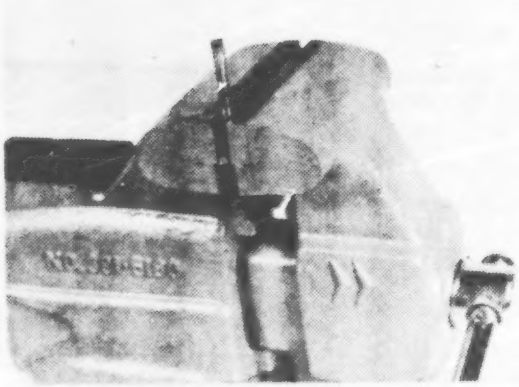
STEP 2 – Start the die on this rod keeping it level.



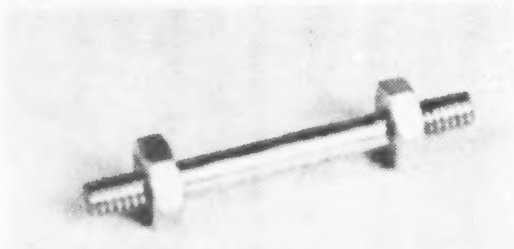

STEP 3 – Thread this rod ½" (1.27 cm). Turn it over and thread the other side ½" (1.27 cm) long.



STEP 4 – Wrap the threads of the rod in a piece of cloth or paper to protect them from the jaws of the vise.



STEP 5 – Take the rod out and put the second rod in the vise. Repeat Steps 2, 3, and 4.



STEP 6 – Put a 12-24 nut on one end of each rod and tighten it.

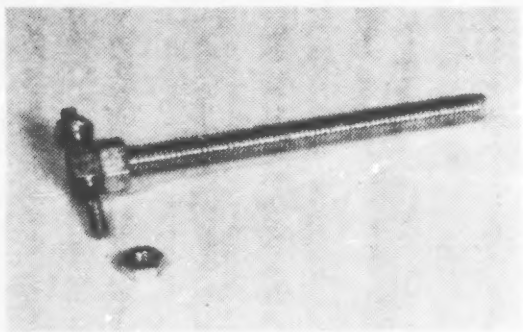
## Check Point

Are the nuts tight?

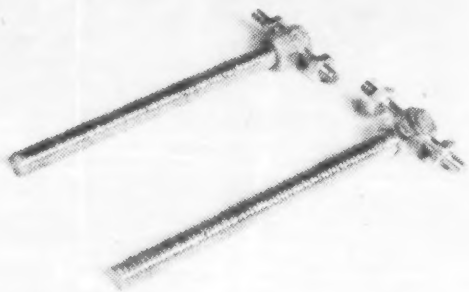
If so, proceed to the final Instructional Objective.

## Instructional Objective XIX

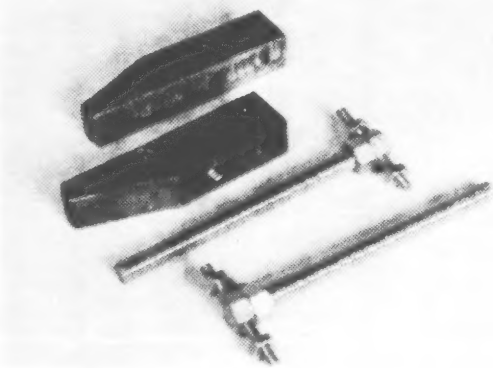
The student will assemble the parts of the C-clamp.



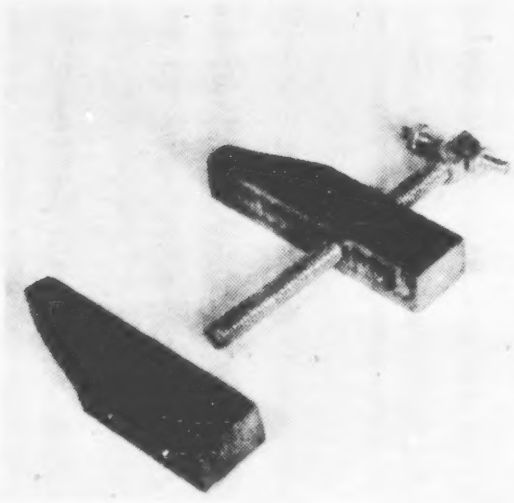
STEP 1 – Slip the 3/16" (.47625 cm) rod through the hole that was drilled through the 3/8 nut and rod.



STEP 2 – Put a 12-24 nut on the other end of the rod. This is the tightening handle for the C-clamp.

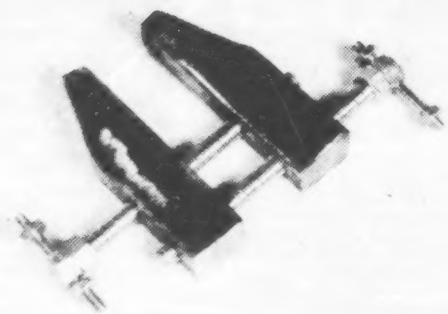


STEP 3 – Repeat Step 2 to the other 3/16" (.47625 cm) rod.



STEP 4 – Assemble all the parts that have been made by looking at the handout given to you by your instructor.

## Check Point



Does your C-clamp look like your picture?

Does it operate properly?

**606.682-014 DRILL-PRESS OPERATOR (mach. shop) production-drilling-machine operator.**

Operates previously setup drilling machines, such as single- or multiple-spindle drill presses to drill, ream, countersink, spot face, or tap holes in metal or nonmetal workpieces according to specifications: Lifts workpiece manually or with hoist, and positions and secures it on machine table in drilling *jig* or holding *fixture.* Moves machine controls to feed tools into workpiece, and engages automatic feed. Observes machine operation and verifies conformance of drilled workpiece to specifications, using fixed gages, calipers, and micrometers. Changes worn cutting tools, using wrenches. Moves controls to adjust cutting speeds, feed rates, and depth of cut. May assist JOB SETTER (fabric. plastics prod.; mach. mfg; mach. shop) in setting up machine. May sharpen cutting tools, using *bench grinder.* May perform minor assembly, such as fastening parts with nuts, bolts, and screws, using power tools and handtools. May be designated according to product as BARREL REAMER (firearms); or function of machine as REAMER OPERATOR (mach. shop); TAPPER OPERATOR (mach. shop).

**607.382-010 CONTOUR-BAND-SAW OPERATOR, VERTICAL (mach. shop)**

Sets up and operates vertical contour-band saw to cut straight, curved, irregular, or internal patterns in metal or plastic stock, according to specifications, utilizing knowledge of sawing techniques: Reads work order or blueprints to locate cutting layout lines on stock, to determine dimensions and tolerances, and to determine metal to be cut, type of blade to be used, blade tension, cutting speed, feed rate, table angle, and positions of table stops and guides. Relieves saw blade support and drive-wheel tension to change blade and adjust tension. Turns controls to set prescribed cutting speed, feed rate, and table angle. Loosens table stops and guides, using handtools, and positions them to aline and secure workpiece. Places stock on cutting table, either manually or using hoist, and clamps it into position. Cuts saw blade, threads it through hole drilled in stock, welds blade together, using butt-welding attachment, and files weld smooth to cut internal pattern in stock. Starts saw and manually guides stock along layout lines to cut pattern, or engages automatic feed to cut straight line. Turns control to start airflow to blow metal cuttings away from kerf. Verifies conformance to specifications, using ruler, calipers, fixed gages, templates, and micrometers. May take precision cuts, using magnifier to see layout lines. May calculate and mark layout lines according to product specifications. May be required to have experience with particular product or size, type, or trade name of machine.

**600.280-022 MACHINIST (mach. shop) machinist, all-around; machinist, first class; machinist, general; machinist, precision.**

Sets up and operates machine tools, and fits and assembles parts to make or repair metal parts, mechanisms, tools, or machines, applying knowledge of mechanics, shop mathematics, metal properties, and layout and machining procedures: Studies specifications, such as blueprint, sketch, damaged part, or description of part to be replaced, to determine dimensions and tolerances of piece to be machined, sequence of operations, and tools, materials, and machines required. Measures, marks, and scribes dimensions, and reference points to lay out stock for machining [LAY-OUT WORKER (mach. shop)]. Sets up and operates metal-removing machines, such as lathe, milling machine, shaper, or grinder, to machine parts to specifications. Verifies conformance of workpiece to specifications, using measuring instruments [TOOL-MACHINE SET-UP OPERATOR (mach. shop)]. Positions and secures workpiece in holding device, such as chuck or collet, or on surface plate or worktable with such devices as vises, V-blocks, and angle plates, and uses handtools, such as files, scrapers, and wrenches, to fit and assemble parts to assemblies or mechanisms. Verifies dimensions and alinement with measuring instruments, such as micrometers, height gages, and *gage blocks.* May operate mechanism or machine, observe operation, or test with inspection equipment, to diagnose malfunction of machine or to test repaired machine. May perform flame cutting and arc or gas welding operations, when required. May develop specifications from general description and draw or sketch product to be made.